

Original Article

Transfer and University–Industry Interaction Under Brazil’s Informatics Law: Evidence from Recent Innovation Policy Outcomes

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Abstract: *This study analyses the effectiveness of the Brazilian IT Law as a public policy instrument to promote technology transfer and university–industry interaction in Brazil’s information and communication technology sector. Despite Brazil’s strong scientific output, significant challenges remain in converting academic knowledge into industrial innovation. A documentary and descriptive approach was adopted, based on statistical reports published by the MCTI for the period 2020–2022. The analysis focused on indicators related to industrial revenue, mandatory R&D investments, transfers to accredited research institutions and technological outputs. The theoretical framework draws on technology transfer, absorptive capacity and innovation systems literature. Results indicate that although financial investments remain substantial and institutional cooperation has expanded, technological outputs are still uneven and concentrated in specific categories. The findings suggest that the policy strengthens institutional interaction, but structural barriers continue to limit broader innovation impacts and industrial technological maturity.*

Keywords: *Technology Transfer, Innovation Policy, University–Industry Cooperation, Absorptive Capacity, ICT Sector.*

I. INTRODUCTION

Over recent decades, innovation has undergone a significant conceptual transformation. What was previously understood as an isolated activity developed within firms or research laboratories is now recognised as a dynamic process shaped by the interaction of multiple institutional actors. Within this perspective, the Triple Helix model, proposed by Etzkowitz and Leydesdorff (2000), has become one of the most influential theoretical frameworks for explaining how universities, industry and government interact to foster innovation, entrepreneurship and economic development (Etzkowitz and Zhou, 2017). This approach departs from linear interpretations of technological development and emphasises the systemic character of innovation, in which scientific production requires institutional mechanisms capable of converting knowledge into socially and economically applicable outcomes.

In the Brazilian context, however, an important structural contradiction remains evident. The country is one of the largest producers of scientific output globally, ranking 13th among all nations when considering both high- and low-income countries (Pais, 2018), but this manufacturing does not translate to world innovation indices at scale, either driven by government or private sector sources [Brasil2020]. This imbalance exposes an enduring failing of the national innovation system: it is hard to turn scientific capability into industrially relevant and commercially exploitable technologies. In this regard, one of the most important mechanisms for technology transfer is the fact that it migrates scientific results and technical knowledge as well as intellectual assets from academia to productive sectors (Marchetti et al., 2024). However, a few challenges still need to be faced that hinder this transfer of knowledge from laboratories to real implementation at industrial scale, mainly in the translation from laboratory research towards real industry use.

Brazil, faced with this challenge, turned its attention to the design of public policies specifically targeted at strengthening research and innovation activities. The Brazilian IT Law (Lei de Informática) is one of the most relevant instruments in this respect in the information and communication technology sector. Instead of being only a financial stimulus, this policy provides a binding regulation that obliges beneficiary companies to spend at least an obligatory portion of their total income on research and development (R&D) expenditures in accredited scientific and technological institutions (Carneiro et al., 2023). This institutional design creates a structured financial bridge between private companies and research organisations, encouraging long-term cooperative innovation arrangements.

Despite the volume of financial resources mobilised over more than three decades, important questions remain regarding the real effectiveness of this policy in promoting technological development. Studies show that most of the beneficiary firms still



view the mechanism mainly as a cost-cutting tool (Pereira et al., 2025), rather than as an instrument for technological development. Furthermore, the existence of an apparent technological Valley of Death still prevents a range of scientific achievements from progressing to industry-ready applications (Bergamini, 2020). Therefore, the central research problem guiding this study is: to what extent has the Brazilian IT Law effectively contributed to reducing the gap between scientific production and innovation through university–industry interaction and technology transfer?

The general objective of this article is to evaluate the effectiveness of the Brazilian IT Law as a mechanism for university–industry interaction, examining how mandatory R&D investments have contributed to technology transfer and innovation in Brazil. Specifically, the study analyses the most recent statistical reports published by the Brazilian Ministry of Science, Technology and Innovation (MCTI), focusing on indicators related to industrial revenue, institutional investment flows, technological outputs and nationally recognised technological products.

This study is justified scientifically because current evaluations of innovation policy frequently emphasise financial volume rather than technological effectiveness. Understanding whether these investments generate measurable technological outputs is essential for assessing the maturity of Brazil’s innovation ecosystem. In practical terms, the topic gains additional relevance considering recent changes in the regulatory framework, especially after the reformulation of the law and the adoption of stricter accountability requirements from 2020 onwards (Brasil, 2022).

Furthermore, analysing the most recent period is particularly relevant because it coincides with a phase of accelerated digital transformation and increasing pressure for technological sovereignty in emerging economies. The interaction between accredited research institutions and firms in strategic technological sectors may reveal important patterns concerning absorptive capacity, institutional coordination and the effectiveness of public innovation instruments.

This article is organised into four sections. Following this introduction, the theoretical framework discusses the main concepts related to technology transfer, absorptive capacity and university–industry cooperation. The methodology section then describes the documentary and analytical procedures adopted. Subsequently, the results and discussion section presents the empirical findings derived from official statistical reports. Finally, the article concludes by highlighting the main implications and future perspectives for innovation policy in Brazil.

II. LITERATURE REVIEW

Technology transfer is widely recognised as one of the central processes within contemporary innovation systems. Rather than a simple movement of scientific outputs, it involves the transmission of knowledge, technical competences, intellectual assets and applied solutions from research environments to productive sectors (Dinnetz, 2018). According to Rosenberg (1982), technological progress depends not merely on invention itself, but on institutional capacity to transform scientific discoveries into economically applicable outcomes. This was later corroborated by Nelson (1993), who emphasized the need for viewing innovation in relation to national systems of interconnected institutions whose interactions influence technological performance.

From this system perspective, we place universities more in an entrepreneurial role. Clark (1998) coined the term entrepreneurial university to describe how universities slowly develop a mission of economic development in addition to their more traditional missions. Such transformation is most conspicuously borne out in patenting, licensing collaboration agreements, research contracts and spin-off company formation.

The Triple Helix framework offers a powerful explanation for the institutional articulation of these processes between university and industry. According to Etzkowitz and Leydesdorff (2000), such a coupling between innovation, universities, firms, and governments is possible when they overlap their traditional roles into hybrid modes of cooperation. In this model, the university is no longer just a knowledge producer but also becomes an economic actor; firms change from solo performers of collaborative learning, observed increasingly by governmental regulatory and financial coordination.

In Brazil, this interaction gained some institutional strength after the enactment of the Brazilian IT Law, which formally founded Technology Innovation Centres as an organisational arrangement devoted to managing intellectual property and negotiating contracts and cooperation between scientific institutions and firms (Paranhos et al., 2018). However, some previous studies suggest that the dynamic of these partnerships is still constrained by bureaucratic rigidity and legal barriers (Paiva et al., 2023).

A crucial complementary concept is absorptive capacity, originally formulated by Cohen and Levinthal (1990). According to these authors, firms must possess internal competences enabling them to recognise external knowledge, assimilate it and apply it commercially. Without such internal capability, even well-structured cooperation with universities may fail to generate innovation.

This perspective is reinforced by later studies showing that technological learning requires more than access to external scientific knowledge. Cassol, Marietto and Martins (2022) show that achieving successful innovation depends on internal organisational routines to convert external inputs into an operational process. In line with this, Cheng, Qiu and Wang (2025) find that public innovation policies are more effective when firms have established technological capabilities.

A second major aspect is the so-called Silicon Valley of Death. This notion is the gulf between early scientific validation and industrial-scale deployment of technology. Rice (2002) points out that many technologies do not obtain sufficient financial and institutional support during the intermediate phases of a development process, which leads to their failure. This challenge is shown to be rather more acute in projects linked with university-generated technologies, as Bergamini (2020) demonstrates for Brazil.

In this regard, the Informatics Law is an institutional mechanism that shapes conditions for cooperation due to its obligatory financial nature. But as repeated by Carneiro et al. Financial allocation does not provide technological success (2023). Effective outcomes depend on governance quality, project alignment, absorptive capacity and the existence of institutional trust between actors.

Finally, recent literature suggests that evaluating innovation policy effectiveness requires attention not only to financial indicators but also to technological outputs capable of demonstrating knowledge internalisation. In this sense, products classified under technological nationalisation criteria become highly relevant empirical indicators, since they reveal whether public policy is effectively contributing to domestic technological capability formation (Barbosa and Granville, 2023).

III. METHODOLOGY

This study is characterised as applied research, as it seeks to generate analytical knowledge capable of supporting practical understanding of policy instruments linked to technological development and innovation performance within the Brazilian information and communication technology sector. Applied research is particularly appropriate when the objective is not only to interpret empirical evidence, but also to produce knowledge with potential relevance for institutional decision-making, public policy evaluation, and strategic improvement of innovation mechanisms.

A mixed-methods approach was adopted, combining quantitative and qualitative procedures in order to provide a more comprehensive interpretation of the phenomenon under investigation. Such an approach serves the purpose of allowing the integration of interpretive analysis with numerical indicators, further empowering explanatory power in this study. For this study, quantitative evidence served as the ground for trend identification while qualitative interpretation allowed analyzing how these trends correlate to existing technology transfer mechanisms created by Brazilian IT Law. Methodologically, the study is descriptive in nature because it attempts to observe and explain distributions of economic performance, institutional interaction, and innovation outputs under a pre-defined policy framework. Rather than testing causal relationships, the research focuses on describing the behaviour of strategic indicators over time and examining how these indicators reflect the operational dynamics of public policy directed at stimulating research, development and innovation.

The technical procedure adopted was documentary research, based on the systematic examination of official documents as primary empirical sources. Documentary research is especially well suited to studies in the institutional programs perspective because it allows direct access to validated administrative data generated within formal regulatory mechanisms. The empirical material will be the official annual reports written and disclosed by MCTI about its execution of the Brazilian IT Law.

The time frame covered was 2020 to 2022, which corresponds to the latest firm-level consolidated dataset publicly available until Q1/26. The time limit is justified because of the regulatory compliance cycle that governs Brazilian IT Law, meaning beneficiary firms have a deadline to submit their Annual Demonstrative Report (RDA) by 31 July in the year after the fiscal period analyzed. After submission, the information undergoes technical verification, fiscal assessment, and possible adjustment procedures conducted by the federal administration. As a result, there is an inherent time lag between the year of economic execution and the official release of fully validated indicators, producing an average delay of approximately three years before reliable consolidated data become available for statistical interpretation.

Data collection focused on extracting strategic indicators directly related to the analytical dimensions presented in the Results section. These indicators included: gross revenue of beneficiary firms, financial transfers directed to scientific and technological institutions, number of collaborative projects financed through formal agreements, technological outputs represented by patents and scientific publications, and economic participation of products classified under recognised national technology criteria (TECNAC). These variables were selected because they jointly capture the principal operational dimensions through which the Brazilian IT Law materialises technology transfer, namely economic scale, institutional cooperation, knowledge generation, and technological appropriation.

To ensure coherence between data presentation and analytical interpretation, the indicators were organised into four analytical groups corresponding to the four figures discussed in the Results section: (i) sectoral economic scale and firm participation; (ii) financial transfers and collaborative projects involving scientific and technological institutions; (iii) technological outputs generated through internal and cooperative efforts; and (iv) the relative economic contribution of TECNAC within the total revenue structure. This organisation allowed a progressive interpretation of how fiscal incentives are transformed into measurable innovation outcomes.

The treatment and systematisation of the extracted information were supported by Google Gemini as an auxiliary operational tool used for structuring tabulated data, organising numerical series, and supporting graphical formatting. Its use was restricted to technical support functions associated with data organisation and figure generation. All decisions related to indicator selection, analytical relevance, interpretation of empirical trends, and the critical examination of how the observed figures reveal structural limitations in technology transfer were conducted exclusively by the author.

The analytical interpretation prioritised consistency between documentary evidence and the broader policy context, particularly the regulatory changes introduced after Law nº 13.969/2019 and the sectoral transformations associated with accelerated digitalisation during and after the pandemic period. This methodological alignment ensured that the empirical results were interpreted not merely as isolated numerical trends, but as indicators of institutional behaviour within Brazil's innovation system.

IV. RESULTS

The empirical evidence presented in this section is based on data extracted from annual reports produced by MCTI covering the period from 2020 to 2022, with particular emphasis on the operational outcomes associated with the Brazilian IT Law after the regulatory adjustments introduced by Law nº 13.969/2019. The four figures collectively illustrate the functioning of the policy from complementary analytical perspectives: sectoral economic scale, financial transfers to scientific and technological institutions, technological outputs generated through collaborative and internal efforts, and the relative contribution of one strategic industrial segment to the overall economic performance of the programme. Together, these dimensions allow an integrated understanding of how fiscal incentives, productive growth, institutional collaboration and innovation outputs interact within the Brazilian technology transfer environment.

The results indicate that, during a period strongly influenced by accelerated digitalisation and post-pandemic restructuring, the policy maintained high economic relevance and continued to mobilise significant volumes of resources for research, development and innovation activities.

The analysis of the three most recent annual reports demonstrates that firm participation in the Informatics Law remained broadly stable during the period, even after the transition from the former industrial tax reduction model based on IPI exemptions to the financial credit system established by the new legal framework. This stability is particularly relevant because institutional changes of this magnitude often generate uncertainty regarding adherence by private firms. In this case, however, the continuity of participation suggests that the incentive structure remained economically attractive and strategically aligned with the needs of the technology sector.

At the same time, the economic scale associated with participating firms expanded substantially. Gross revenue increased from R\$141.4 billion in 2020 to R\$225.8 billion in 2022, indicating strong growth in sectoral economic activity over a short period. This increase is directly relevant to the policy mechanism because corporate revenue forms the basis for calculating mandatory investments in research, development and innovation. Consequently, higher turnover strengthens the volume of resources subsequently channelled to research institutions and collaborative innovation projects.

This growth occurred during a period marked by strong expansion in digital demand associated with the pandemic and its aftermath, when technological products, digital infrastructure and communication systems became increasingly central to economic and social functioning. In this context, the policy operated as an important mechanism through which part of the economic gains generated by rising technology consumption were redirected towards domestic scientific and technological development. The divergence between relatively stable firm participation and sharply increasing revenue also suggests gains in productivity, scale, and market performance among established firms, indicating growing maturity within the sector.

The financial transfers directed to scientific and technological institutions reveal a clear upward trajectory throughout the period analysed. Total transfers reached R\$1.57 billion in 2022, confirming the growing importance of collaborative arrangements between firms and research institutions under the Informatics Law framework. In the same year, approximately 1,143 projects were financed through formal cooperation agreements involving 115 institutions distributed across Brazil.

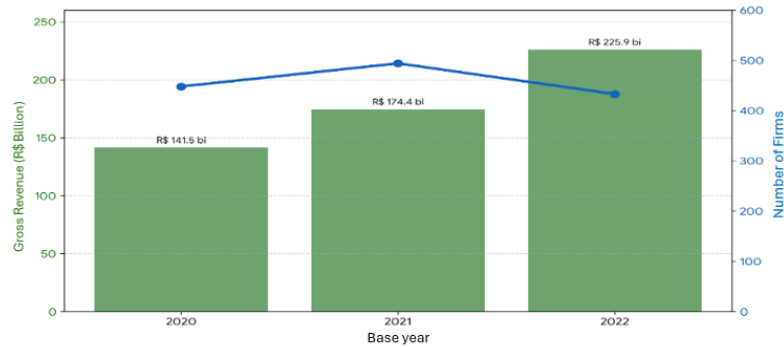


Figure 1. Economic Scale and Business Participation (2020–2022)

Source: Authors' own elaboration.

These resources represent a central mechanism through which fiscal incentives are converted into innovation activity. For research institutions, such transfers contribute not only to specific project execution but also to broader institutional sustainability, supporting laboratories, specialised personnel, equipment acquisition and applied research continuity. For firms, collaboration with external institutions provides access to highly specialised scientific capabilities while reducing technological uncertainty through risk-sharing arrangements.

The legal framework also includes regional redistribution mechanisms designed to stimulate investments outside the country's main industrial centres, particularly through mandatory allocations to areas influenced by the Northeast Development Agency (SUDENE) and the Amazon Development Agency (SUDAM). However, empirical evidence still indicates strong concentration of investments in institutions located in south-eastern Brazil, where industrial density, scientific infrastructure and innovation capabilities remain more developed. Although the policy contains redistributive instruments, structural regional asymmetries continue to influence investment allocation patterns.

The technological outputs generated under the policy framework reveal distinct dynamics between formal intellectual property generation and scientific publication. As for internal patent and industrial design registrations, they have always been more prolific than those developed via cooperative agreements in recent decades, especially seen prominent growth during 2020–21. This suggests firms still retain a significant internal capacity to appropriate technological knowledge and convert it into proprietary assets.

In contrast, 2022 saw 1,143 papers linked to the \$880 million spent on cooperative agreements, and internally generated publications produced a total of 1,637 outputs. This time of increased production could be linked to the aftermath of projects coming into fruition from years prior, or consolidation within collaborative research networks.

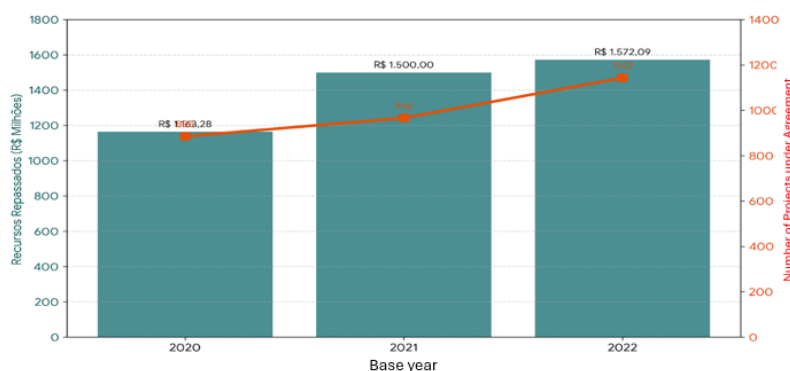


Figure 2. Investment Transfers to ICTs and Collaborative Projects (2020–2022)

Source: Authors' own elaboration.

The coexistence of patent generation and publication growth is analytically important because it reflects two complementary dimensions of innovation performance: appropriability and dissemination. Patents signal efforts to protect technological knowledge and secure competitive advantage, whereas publications demonstrate broader scientific circulation and knowledge diffusion. In technology transfer systems, the balance between these two outputs often indicates the maturity of institutional arrangements linking firms and research organisations.

The data also suggest that collaborative projects tend to generate stronger scientific visibility, while internal activities remain more directly associated with proprietary technological assets. This reflects the distinct institutional logics of firms and research institutions, where firms prioritise competitive appropriation and research institutions often maintain stronger incentives for scientific dissemination.

The analysis of the TECNAC segment demonstrates that, although its share of total revenue remained relatively stable throughout the period, its absolute economic contribution increased consistently. Revenue generated by this segment rose from R\$5.1 billion in 2020 to R\$8.3 billion in 2022, while its proportional participation remained around 3.6% to 3.7% of total gross revenue.

This stability in proportional participation combined with growth in absolute values indicates that TECNAC expanded in line with the broader sector, maintaining strategic relevance within the policy framework. Although its percentage share appears limited when compared with the total volume of participating firms, its sustained contribution demonstrates that specialised technological segments continue to represent important sources of economic activity within the broader incentive system.

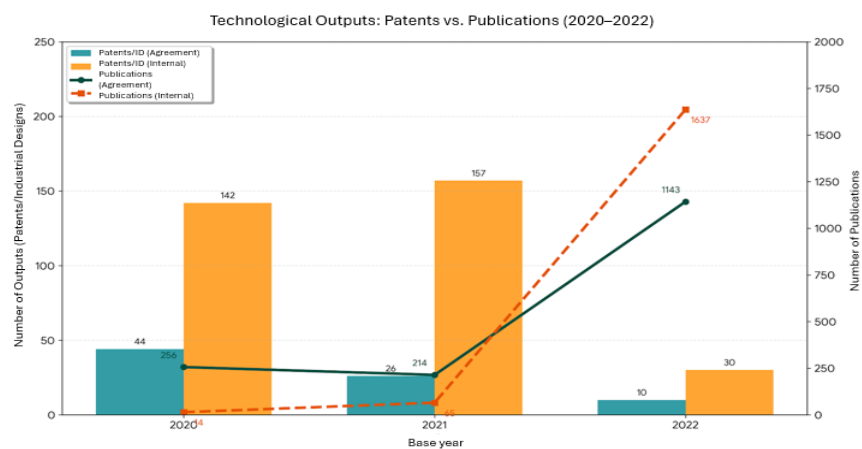


Figure 3. Technological Outputs: Patents versus Publications (2020–2022)

Source: Authors' own elaboration.

From an innovation policy perspective, this behaviour suggests that even segments with relatively stable proportional participation can generate increasing financial relevance as the general market expands. Because revenue remains the basis for calculating mandatory R&D&I obligations, growth within TECNAC also contributes directly to expanding available resources for research cooperation and technology transfer activities.

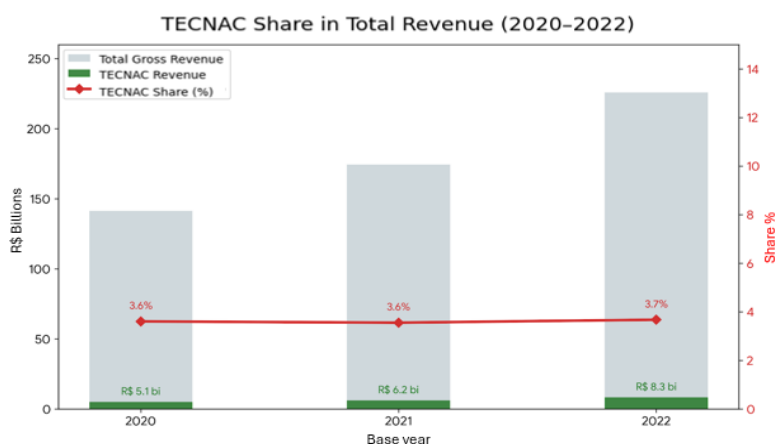


Figure 4. TECNAC Share in Total Revenue (2020–2022)

Source: Authors' own elaboration.

The stability observed further suggests resilience within this segment, indicating that its economic performance remained robust despite broader institutional and macroeconomic adjustments affecting the sector during the analysed period.

V. PROPOSITIONS FOR STRENGTHENING TECHNOLOGY TRANSFER

The evidence presented in this study suggests that future improvements in the Brazilian IT Law should increasingly prioritise technological effectiveness rather than solely financial compliance. Although the policy has ensured significant and continuous investment in research, development and innovation activities, the conversion of collaborative scientific knowledge into intellectual property assets remains limited when compared with the scale of resources mobilised. In particular, the relatively low number of patents originating from projects conducted through formal agreements between beneficiary firms and accredited scientific institutions indicates that technology transfer outcomes still face important structural constraints.

One of the main propositions emerging from this analysis concerns the adoption of stricter monitoring mechanisms specifically focused on intellectual property indicators. Current accountability systems are largely centred on financial expenditure and formal project execution, whereas patent generation, licensing activities and technological ownership remain secondary dimensions in policy evaluation. A more robust monitoring model should therefore include mandatory indicators capable of measuring patent filings, co-ownership between firms and institutions, licensing contracts and technology readiness progression associated with each funded project. Such an approach would allow the policy to move from financial accountability towards technological accountability.

A second proposition concerns the strategic strengthening of the role played by the Technological Transfer Office (TTO) within cooperative projects. At present, Technology Innovation Centres often operate primarily as administrative intermediaries responsible for contract formalisation and intellectual property procedures after technological results have already been generated. However, future policy effectiveness requires these structures to intervene earlier in project development, integrating patent strategy, technological mapping and market assessment from the beginning of the research cycle. This anticipatory role would significantly increase the probability that scientific outputs evolve into protected and transferable technological assets.

Another important proposition involves improving the quality of university–industry cooperation itself. Although institutional partnerships have expanded considerably under the policy framework, many projects still remain limited to short-term technical cooperation rather than cumulative innovation trajectories. For this reason, future regulatory improvements should encourage multiannual cooperation agendas capable of producing technological continuity, allowing successive projects to evolve from scientific validation towards industrial application. This would reduce fragmentation and strengthen the learning process between firms and scientific institutions.

A further critical issue concerns firms' absorptive capacity. As demonstrated by Cohen and Levinthal (1990), external scientific knowledge only generates effective innovation when firms possess sufficient internal capabilities to assimilate and apply technological results. In this sense, future policy mechanisms could establish differentiated incentives that reward firms demonstrating stronger internal research structures, higher co-investment capacity and greater technological maturity. Such differentiation would stimulate deeper technological commitment rather than minimal regulatory compliance.

Regional technological concentration also remains an important issue for future policy refinement. Although decentralisation mechanisms exist within the current framework, technological activity remains predominantly concentrated in historically industrialised regions. Future policy adjustments should therefore strengthen incentives directed towards less consolidated innovation regions, expanding the technological role of accredited institutions located outside traditional industrial centres.

Finally, future evaluations should continue monitoring the effects of recent regulatory reforms, particularly those introduced after the transition from tax exemption to financial credit mechanisms. Since this study covers the most recent available reports from the MCTI between 2020 and 2022, subsequent analyses will be essential for understanding whether the new regulatory design can effectively improve technological outcomes, reduce regional disparities and strengthen Brazil's broader technological sovereignty.

VI. CONCLUSION

This study demonstrates that the Brazilian IT Law continues to represent one of the most structurally relevant public policy instruments within Brazil's national innovation system. Its importance extends beyond fiscal incentives, as it provides a stable institutional mechanism through which firms and scientific institutions maintain continuous cooperation in research, development and innovation activities.

The analysis of official data from 2020 to 2022 reveals that the policy continues to mobilise substantial financial resources and sustain significant flows of investment towards accredited scientific institutions. These transfers reinforce research infrastructure, support technical cooperation and maintain institutional channels through which scientific knowledge can potentially reach productive sectors.

However, the findings also indicate that technological outputs remain uneven and concentrated in specific categories, suggesting that financial investment alone is insufficient to guarantee proportional technological advancement. Although cooperation has expanded institutionally, the conversion of research efforts into patents, higher technological maturity products and scalable industrial solutions remains below the level expected from the policy's historical duration and financial magnitude.

A central conclusion is that technology transfer depends not only on public incentives but also on the interaction between institutional governance, absorptive capacity and technological management quality. In particular, firms' ability to internalise scientific knowledge and transform collaborative research into competitive technological outputs remains decisive for policy effectiveness.

The study also reinforces the strategic relevance of intermediary institutional actors, especially Technology Innovation Centres, whose future role must increasingly involve proactive technological governance rather than merely administrative support. Strengthening these structures will be essential for improving intellectual property outcomes and accelerating the transition from scientific production to industrial innovation.

Finally, the long-term effectiveness of the policy will depend on its capacity to evolve from a predominantly fiscal instrument into a broader strategic framework for technological sovereignty, industrial competitiveness and national innovation capability. In a context of increasing global technological competition, preserving and refining this policy becomes fundamental for consolidating Brazil's position within advanced technological sectors.

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