RCMOS – Multidisciplinary Scientific Journal The Knowledge.
ISSN: 2675-9128. São Paulo-SP.
Year V, v.2 2025. | Submission: 12/20/2025 | Accepted: 12/22/2025 | Publication: 12/24/2025

Innovation in the Brazilian pharmaceutical sector: public policies, investments and cooperation (2008–2021)

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Summary

The Brazilian pharmaceutical and fine chemical sector occupies a strategic position in the economy and on the public health agenda, as its innovative capacity conditions both industrial competitiveness and the expansion of access to medicines and therapies. The COVID-19 pandemic directly highlighted the sector's dependence on continuous investments in research, development, and innovation, as well as the need for greater coordination between industry, research centers, and government funding instruments. In this context, this study analyzes the evolution of investments in innovation in the Brazilian pharmaceutical sector, considering the role of public policies, patent filings, and the cooperative dimension of innovative development. Methodologically, a quantitative-qualitative approach is adopted, using secondary data and a literature review, aiming to reconstruct, from a historical perspective, how different government orientations and institutional arrangements influenced the sector's innovative performance. The findings indicate a lack of homogeneity in the innovation trajectory, associated with policy discontinuity and alternating public priorities, which favored the concentration of investments in generic drugs, frequently with a low degree of technological novelty. It is concluded that the consolidation of a consistent, predictable, and lasting public policy is a condition for raising the level of innovation and sustainably strengthening the pharmaceutical and fine chemical sector in Brazil.

Keywords: Public Policies. Investments. Pharmaceutical Sector. Innovation.

Abstract

The Brazilian pharmaceutical and pharmochemical sector plays a strategic role in both economic development and public health, as its innovative capacity affects industrial competitiveness and the expansion of access to medicines and therapies. The COVID-19 pandemic highlighted the sector's dependence on continuous investment in research, development and innovation, as well as the need to strengthen coordination between industry, research centers and governmental support instruments. In this context, this paper examines the evolution of innovation-related investments in the Brazilian pharmaceutical sector, considering public policies, patent filings and cooperative innovation development.
The study adopts a mixed quantitative and qualitative approach, combining secondary data with a bibliographic review to provide a historical assessment of how governmental

priorities and institutional arrangements have shaped innovation outcomes. The findings indicate a lack of uniform growth in innovation, largely related to policy discontinuity and shifting public priorities, which has favored investments in generics that often involve limited technological novelty. The paper argues that a consistent, predictable and long-term public policy framework is necessary to raise the level of innovation and to sustainably strengthen the Brazilian pharmaceutical and pharmochemical sector.
Keywords: Public policy. Investments. Pharmaceutical Sector. Innovation.

1 INTRODUCTION

The Brazilian pharmaceutical sector is among the most important segments. economic and social, by bringing together activities aimed at production, marketing and logistics. of pharmaceutical chemicals, medicines and pharmaceutical preparations, directly influencing the national capacity to develop pharmaceuticals and health technologies (Vieira, 2020). Despite Despite this central role, the innovative trajectory of the sector in the country still faces obstacles. structural issues, such as insufficient investment in research and development, limitations tax incentives and regulatory requirements that can prolong the approval cycle and diffusion of new medicines (Prata, 2018; Capanema, 2007).

The COVID-19 pandemic reinforced the strategic importance of the complex. pharmaceutical, by simultaneously highlighting the demand for rapid technological solutions and the absence of continuous and structured public investment policies aimed at activities Research and Development (R&D). In this context, the need for... to strengthen mechanisms for interaction between research centers and industry, in order to to promote knowledge transfer, productive scalability, and acceleration of technological solutions (Reis; Pieroni, 2021).

In parallel, the expansion of the domestic market and the implementation of pro-reforms Market factors have contributed to expanding the operations of transnational companies in Brazil, with presence of groups such as Pfizer, Novartis, Sanofi and Roche, including R&D initiatives in national territory. It is estimated that such companies account for a significant portion of the pharmaceutical sales market in the country, highlighting the importance of policies capable of guiding the competitive and innovative dynamics of the sector (Prearo, 2022).

Among the instruments that support innovative activity, the following stand out: Patent protections, because they reduce the risk of misappropriation and allow... recovery of investments applied to research, development and production (Radaelli) et al., 2012). However, the patent system in Brazil is the subject of debate, as the costs Associated with protected medicines, they may restrict access and, in certain cases,

In certain contexts, limiting the production of generic drugs is a more economically viable alternative for part of the population (Paranhos; Mercadante; Hasenclever, 2020).

Furthermore, barriers to entry and the concentration of capital can favor oligopolistic structures, expanding the bargaining power of large companies and reducing the competitive capacity of small and medium-sized organizations; this dynamic is It is also associated with the inadequacy of investment policies specifically aimed at these agents. In this sense, it becomes relevant to improve deposit procedures and patent processing, especially for companies with less administrative capacity and financial, in order to reduce bureaucratic obstacles and broaden the conditions for participation. innovative.

Considering that innovation has direct implications for health and well-being. From society's perspective, the continued investment in R&D and advanced technologies is... associated with improving the effectiveness and accessibility of medicines and therapies (Reis; Pieroni, 2021). In light of this, the present work seeks to answer the following question: which Factors contributed to the evolution of the pharmaceutical and fine chemical sector in Brazil between 2008 and 2021? Thus, the general objective is to analyze the evolution of investments in Innovation, public policies, and cooperative innovation development in the sector. Brazilian pharmacist.

Specifically, the aim is to verify quantitatively: (i) the companies that implemented innovations during the period; (ii) the values of expenditures on activities innovative and net sales revenues; (iii) the main destinations of resources for innovation; (iv) patents filed; (v) companies that have implemented innovation product and/or business process and maintained cooperative relationships with others organizations; (vi) the sources of funding for internal R&D activities; (vii) the Companies that implemented innovations and received government support, by type of program; and (viii) the effect of the pandemic on innovative companies.

Finally, the research is justified by the complexity of the relationship between innovation, public policies, cooperation, and protection of intellectual property, which requires reconciling the encouragement of technological development with guaranteeing access to treatments and medications, with direct repercussions on the population.

2. Theoretical Framework

Since the formation of the pharmaceutical sector in Brazil, a dependence has been observed. This refers to the structural nature of knowledge produced outside the country and foreign investment. The situation intensified with the increasing technological complexity of medications. because, historically, Brazilian companies have not had sufficient capital available and technical and scientific skills to support ongoing research activities and Development (R&D) (Coelho, 1980).

In an institutional context, patents constitute a mechanism for incentive and... economic return associated with investments in time and capital employed in research. that result in innovation. In this sense, patent protection, granted by the State, It seeks to protect inventions and stimulate innovation, granting the holder the exclusive right. commercial exploitation for a determined period (Campos, 2011).

However, the magnitude of resources required to develop new The high cost of pharmaceuticals means that few companies are able to make large expenditures and continuous investment in R&D. This asymmetry creates barriers to entry in the sector and favors... economic concentration, with a propensity for the formation of oligopolistic structures, especially in markets associated with innovative products (Palmeira Filho et al., 2012; Pimentel et al., 2013).

Given the market failures resulting from these barriers, public policies of Investment and incentives become necessary to promote positive externalities to... sector. In particular, the adoption of policies is advocated as a response to external dependence. of the Brazilian pharmaceutical sector, given its impact on technological autonomy and productive capacity of the country (Ferst, 2013; Franculino, 2017).

From a historical perspective, national companies have consolidated themselves especially between the 1930s and 1940s, driven by import substitution policies. However, during that same period, multinational companies used acquisitions and mergers to circumventing institutional barriers, initiating a process of denationalization of the sector, with significant foreign capital expenditures in the country (Paranhos, 2012). Between 1940 and 1950, the Brazil has expanded the opening of its domestic market to foreign companies, with policies favorable to transnational corporations, which deepened the inflow of foreign investment (Paranhos, 2012).

This process intensified between 1955 and 1960, during the government of Juscelino Kubitschek, when there was active encouragement for the entry of foreign capital. A

Brazil's technological lag at the time also proved to be a factor in attracting investment.
international investors (Coelho, 1980).

In the 1980s, a partnership was established between the Development Company
Technological Development Center (CODETEC) and the Central Pharmacy (CEME). In this initiative, the
CODETEC would assume investments in reverse engineering for the production of new
pharmaceuticals, while CEME would handle the acquisition of the manufactured medicines,
configuring an arrangement focused on building productive and technological capacity.
(Paranhos, 2012).

Still, even with incentives for the production of technologies and medicines,
Many national companies lacked the financial capacity to invest in R&D.
Adding to this is the absence of a sufficiently efficient patent regulatory apparatus.
for the pharmaceutical sector, which further discouraged innovative investment.
(Capanema; Palmeira Filho, 2004).

After the return to democracy, a set of policies began to influence the sector.
Pharmaceuticals and pharmaceutical chemicals, directly or indirectly. The main initiatives of this period,
According to the source text, they are systematized in Table 01.

Table 1 - Public policies for innovation in the Brazilian pharmaceutical sector

Government	Year	Policy	Objective
Joseph Sarney	1988	New Industrial Policy (NIP)	To provide incentives for the development of new technologies and the expansion of Brazilian industries in general.
Fernando Collor Mello	1990	Industrial and Trade Policy Exterior (PICE)	Guidelines that encouraged spending on production capacity, proposing awards, with the support of BNDES, for competitive companies.
Itamar Augustus Franco	1993	Law 8.661	Promote tax incentives for companies that invest in R&D.
	1994	TRIPS Agreement	Recognizing pharmaceutical patents, guaranteeing exclusive production rights to laboratories for 20 years. This would attract foreign capital and encourage investment in R&D.
Fernando Henry Cardoso	1996	Law No. 9,279	Protect intellectual property and encourage R&D.
	1998	National Medicines Policy (PNM)	To improve pharmaceutical care within the Brazilian public health system (SUS) and stimulate scientific development.
	1999	Generic Drugs Law	Allowing companies to exploit expired patents, with the aim of reducing the cost of medicines, sometimes eliminates the need to invest in research to create a new product.

			medication.
	2000	Millennium Institutes Programme	Sponsoring virtual R&D labs in various fields.
Louis Ignatius Lula da Silva	2004	Industrial, Technological and Financing Policy for	the purchase of national machinery and reducing foreign trade (PITCE) Taxes in certain sectors, thereby stimulating technological development and production capacity.
		Partnership with BNDES	Through the PROFARMA program, a line of credit was created for the pharmaceutical sector to invest in innovation.
		Popular Pharmacy Program	The program's aim was for the government to purchase medications and provide them to the population free of charge, as well as subsidize a percentage of some medications.
	2004	Law 10.973 - Innovation Law	It established cooperative environments between private companies and public universities, as well as promoting investment in innovation for companies through investment funds.
	2005	Law No. 11,196	It provided tax incentives for companies that invested in R&D, as well as encouraging companies to establish partnerships with ICTs. The law also provided for the financing of R&D by companies, with the Financing Agency for Studies and Projects (FINEP) acting as the operational entity for investment.
	2007	The Growth Acceleration Program aimed to encourage increased investment from private sources (PAC).	Public investments in R&D, infrastructure, and innovation in the product area, including the substitution of inputs, had a specific branch for the pharmaceutical sector.
	2008	Partnerships for Development Productive (PDPs)	It aimed to stimulate partnerships between private companies and public laboratories, where companies would participate in the profits derived from innovative products created by this partnership, in addition to a ten-year market reserve, provided that the company assumed responsibility for the profits resulting from investment in innovation.
Dilma Rousseff	2011	Brazil Greater Program (PBM)	Through goals, guidelines, and policies, the program aimed to stimulate the creation of technology to develop the production chain and facilitate the export process, making it less onerous. The program also targeted micro and small businesses.
	2011	Bill 2177/2011, named Brazilian Code of Science, Technology and innovation	It proposed the participation of researchers from public institutions in research projects carried out Partnerships with the private sector, in a less bureaucratic way, streamlining research and encouraging the emergence of new technologi
	2012	Decree 7.713	Public tenders would give preference to the purchase of medicines with differentiated prices, if these are produced with national inputs and are the result of national innovations.
Michel Fear	2018	Decree 9.283 (new legal framework)	Through the amendment of several laws and the reduction of bureaucracy, the Legal Framework for Science, Technology and Innovation was established. (NMCTI) - provides for the promotion of research, science, technology and innovation, as well as scientific and technological training.
Louis Ignatius Lula da	2023	Senate Resolution Project No. 69	Establishes the Parliamentary Front for the Development of Industry Pharmaceuticals and the Production of Pharmaceutical Inputs Activities Brazil

Silva			

Source: Author's own work (2025)

After systematizing Table 1, it is observed that the selection prioritizes policies.
geared towards supporting private companies and universities as instruments to stimulate
Investment in innovation. However, policies emphasizing investment in innovation are also being recorded.
Accessibility to medicines, notably the Generic Drugs Law and the Pharmacy Program.
Popular (Dias; Romano-Lieber, 2006; Pereira, 2013).

Furthermore, the New Legal Framework for Science, Technology and Innovation stands out.
(NMCTI), in effect since 2018, focuses on instruments aimed at stimulating
science and the pursuit of reducing bureaucratic obstacles. Within the pharmaceutical sector, the
The milestone is associated with institutional improvements aimed at expanding conditions for
scientific and technological development (Rocha, 2019).

3. Materials and Methods

It should be noted that this work adopted a mixed approach (quantitative and
qualitative), involving the collection and analysis of information about the pharmaceutical sector, especially
with regard to innovation, investment and government economic incentives.
In conceptual terms, quantitative research guides the collection and processing of data.
Numerical research, while qualitative research contributes to exploring and interpreting ideas.
social and institutional phenomena, broadening the understanding of the object of investigation.
(Creswell, 2014).

In the qualitative aspect, a literature review was conducted to provide support.
and interpret the results from the quantitative approach, as well as from
to understand present events in light of past processes and decisions, considering the
Public policies applied to the pharmaceutical sector, both directly and indirectly. For this stage,
Google Scholar, Science, and the CAPES Portal were used as reference sources.
Scientific Electronic Library Online (SciELO).

In the quantitative area, a database was constructed with variables relating to
period from 2008 to 2021, allowing for systematic analysis of information.
considered relevant for the diagnosis and understanding of the sector's evolution
pharmaceutical. The collection was carried out analytically, based on secondary sources, and the
The data were processed and filtered with the aim of presenting specific indicators of

sector, including analyses relating to pharmaceutical companies. The database was compiled from data from the Brazilian Institute of Geography and Statistics (IBGE) and the National Institute of Industrial Property (INPI), organized into sets of variables systematized in Table 02.

Table 2 - Variables of the Brazilian pharmaceutical and fine chemical sector between 2008 and 2021

VARIABLES	PERIOD	SOURCE
Innovation	2008 to 2017	IBGE - Innovation Survey - PINTEC
Expenditure in relation to revenue	2008 to 2017	IBGE - Innovation Survey - PINTEC
Destination of expenditures	2008 to 2017	IBGE - Innovation Survey - PINTEC
Patents	2008 to 2017	INPI
Cooperation	2008 to 2017	IBGE - Innovation Survey - PINTEC
Funding sources	2008 to 2017	IBGE - Innovation Survey - PINTEC
Funding programs	2008 to 2017	IBGE - Innovation Survey - PINTEC
Pandemic Effect	2021	IBGE - Innovation Survey - PINTEC

Source: Adapted from IBGE - Innovation Survey - PINTEC.

Organizing this information enabled a comparative analysis between the group and selected industry classes, with the results being compiled from the observation of changes in the main variables of each set. The procedure of The research aimed to gather data related to the evolution of industrial production in the sector. pharmaceutical, noting that the values have been deflated and corrected in order to disregard the influence of inflation.

4. Results and Discussion

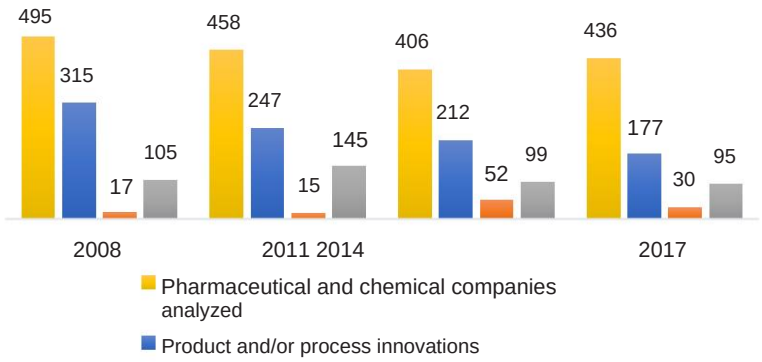
From a strategic point of view, innovation allows companies to build advantages. Sustainable competitive advantages against competitors, strengthening competitive positioning. and to foster an organizational learning environment. From this perspective, innovation is central to business competitive strategies (Porter, 1998). In light of this Understanding this, this work analyzes the evolution of innovation in the pharmaceutical sector and pharmaceutical chemist.

The analysis shows that, within the time frame investigated, there was an absolute reduction. in the participation of companies that implemented innovations. As shown in Graph 01, in In 2008, 88% of companies implemented some type of innovation in the sector; in 2017, that figure had risen.

The percentage dropped to 69%, representing a decrease of 19 percentage points.
Conversely, the participation of companies with incomplete and/or abandoned projects.
It increased from 3% to 7% between 2008 and 2017.

This slowdown in innovation implementations was not limited to the sector.
pharmaceutical and pharmaceutical chemical, since, in the group of companies analyzed, 76%
implemented some type of innovation in 2008, while in 2017, that percentage was...
67%, indicating an overall reduction in innovation implementations in the market.

Chart 1 - Brazilian pharmaceutical and chemical companies that implemented innovations between 2008 and 2017



Source: Adapted from IBGE - Innovation Survey - PINTEC.

It can be observed, therefore, that the sector was strongly affected between 2008 and 2017. In light of
From the theoretical framework, an explanation for this scenario, especially in the segment...
The problem in the pharmaceutical industry is the scarcity of efficient public policies to encourage innovation during this period.
subsequent to the governments of Luiz Inácio Lula da Silva and Dilma Rousseff. Additionally, the
transition from the Dilma Rousseff government, associated with expansion, to the Michel Temer government,
Associated with the recession up to 2017, it is related to the reduction in the number of stimulus policies.
innovation.

In this direction, the work converges with Mascarello (2021), who, when examining
governments and policies aimed at the pharmaceutical sector since the redemocratization, no
It identified relevant policies for the sector from the Dilma Rousseff administration until 2017.

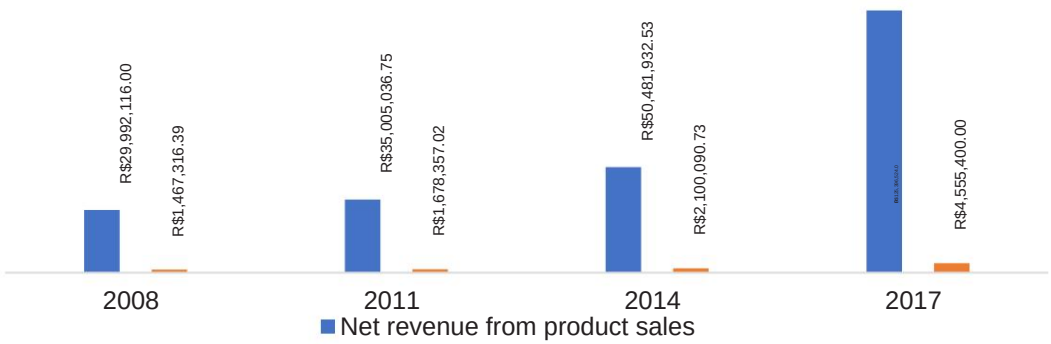
Another element associated with the decrease in innovation implementation is the effect.
the Generic Drugs Law, which encouraged the local pharmaceutical industry to invest in
infrastructure between 2000 and 2008, a period in which multinational companies demonstrated less
interest in this segment, creating an opportunity for the national industry (Capanema;
(Palmeira Filho, 2010). After modernization, these companies tended to reduce the

The need for significant investments in innovation arose, as they began to exploit patents.
defeated (Paranhos, 2012).

Despite the percentage reduction in the number of companies in the pharmaceutical sector
By investing in innovation, the volume of resources allocated to innovative activities has increased.
sharply, as shown in Graph 02, with growth of 310% between 2008 and 2017.
This evidence supports the inference that a subset of companies maintains
Continuous and intensive investment in innovation as a differentiation strategy.
competitive.

Considering the analyses on the effects of generic drugs and Pinheiro's study,
Rapini and Paranhos (2021), who identified a predominance of large companies among the
Regarding users of FINEP financing programs, it can be stated that the largest share of
The amount invested in innovation tends to be concentrated in these companies. For firms
For smaller companies, working with generic drugs proves to be relatively more accessible, due to...
Lower costs. Thus, a scenario of concentration is consolidated, in which large
Companies are expanding in size and market share compared to small businesses.

Chart 02 - Net revenue from sales and expenditures on innovative activities by Brazilian pharmaceutical and chemical companies between 2008 and 2017



Source: Adapted from IBGE - Innovation Survey - PINTEC.

Graph 2 also indicates the ratio between investment in innovation and revenue.
It decreased progressively from 2008 to 2017. In 2008, the percentage was 4.89%; in 2017,
It decreased to 3.63%, corresponding to a drop of 1.26 percentage points. Considering that the
The sample includes several companies; this average value may hide larger reductions.
part of them.

Furthermore, the percentage of investment in innovation relative to revenue in the sector.
The Brazilian pharmaceutical and pharmaceutical chemical industry remains below that observed in other countries.
leaders. Ferreira Júnior (2019) points out that, in the United States, the average investment in

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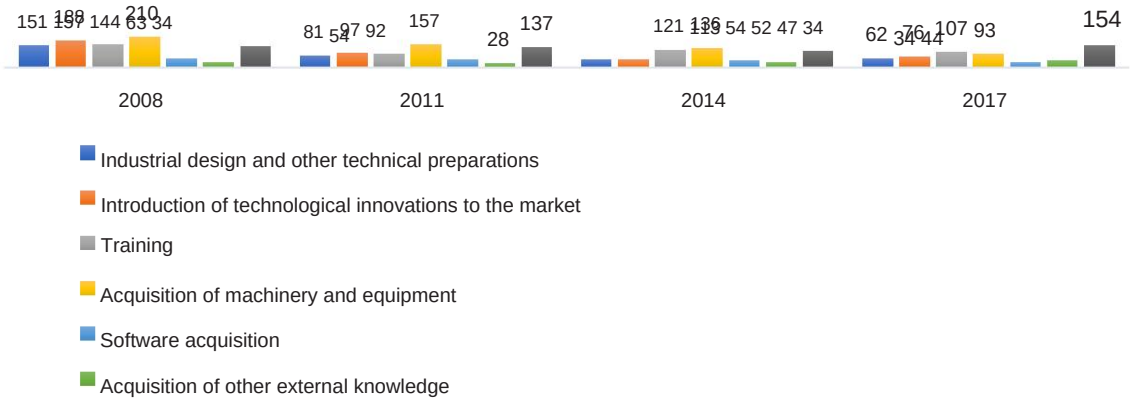
ISSN: 2675-9128. São Paulo-SP.

Innovation in the pharmaceutical sector accounted for 15.06% of sales revenue between 2009 and 2015. The comparison supports the conclusion that Brazil remains far from the level of the main... industry leader, with percentages below 5% in the period analyzed.

Even though, in 2017, investment in innovation as a percentage of revenue in the sector Although the Brazilian pharmaceutical sector has only reached 3.36%, Prearo (2022) notes that, in In the same year, the Brazilian market for the sector reached a record value in the period from 2008 to 2020. reaching US$ 25.46 billion.

Regarding the allocation of innovation expenditures between 2008 and 2017, see Graph 03. evidence shows that the main destinations were, firstly, the acquisition of machinery and, Secondly, internal research and development activities. This result is consistent with Mascarello (2021), who, when examining PINTEC data, arrived at the same conclusion. In conclusion, it adds that investments in the acquisition of machinery tend to be beneficial. incremental innovation.

Chart 3 - Destination of expenditures and innovation carried out by Brazilian pharmaceutical and chemical companies between 2008 and 2017

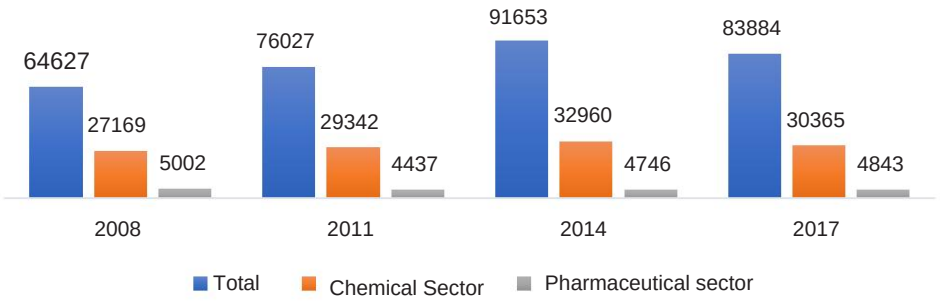


Source: Adapted from IBGE - Innovation Survey - PINTEC.

The patents filed constitute a central dimension for analyzing the evolution of Investment in innovation in the pharmaceutical sector directly reflects the volume of innovations developed. For this investigation, it was decided to consider only patents from Intellectual Property (IP) type, since the other types are not very significant. or nonexistent for long periods. Furthermore, in the development of new drugs. And of disruptive innovations, this type is particularly relevant for analysis.

According to Graph 4, the number of patents filed decreased between 2008 and 2011, with an approximate reduction of 11%. Then, there was growth in the period from 2014. in 2017, corresponding to 8% compared to 2011. Even so, in 2017 the sector remained with 3% fewer patents than in 2008.

Chart 04 - Patents of the PI type filed with the INPI in Brazil between 2008 and 2017.



Source: Adapted from INPI (2025).

In addition to the reduction in the absolute number of pharmaceutical patents during the period The analysis also showed a decrease in the share of these patents in the national total: in 2008, They represented 8% of patents filed in the country; in 2017, they came to represent 6%.

When considering simultaneously the reduction of patents and the misalignment between the number of companies investing in R&D and variations in patent filings — given that, In 2014, the number of companies that invested in innovation decreased, while... Deposits increased — it can be inferred that few companies persistently maintained them. high expenditures of time and capital on R&D. This reading reinforces the hypothesis that a A limited number of organizations sustains innovative progress in the country.

As previously mentioned, large companies concentrate greater capacity to spend time and capital. This asymmetry favors the formation of oligopolies in the pharmaceutical sector, especially in new drugs, deepening the The distance between large and small companies is increasing, and the emergence of new businesses is becoming more difficult. new major competitors in the market.

Interorganizational cooperation is a key element for innovation. because it can reduce costs and combine complementary specializations, speeding up processes. innovative and expanding the environment for generating ideas.

As discussed in the literature review, the government encourages partnerships between private and public organizations, and especially universities. This format of cooperation contributes both to the integration of young people into the job market and to to facilitate the launch of innovative products by private companies.

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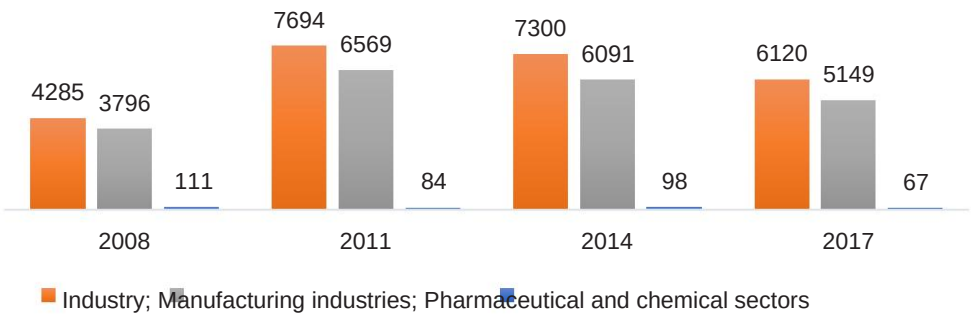
ISSN: 2675-9128. São Paulo-SP.

Graph 5 shows the proportion of companies that implemented innovation.
product and/or business process and maintained cooperative relationships with others
organizations, with a focus on the pharmaceutical and fine chemical sectors. An increase in
Percentage of companies that innovated through cooperation: in 2008, 35.33%; in 2017, 37.63%.
totaling an increase of 2.3 percentage points.

Chart 05 - Companies that implemented product and/or process innovation and maintained cooperative relationships with other organizations in Brazil between 2008 and 2017.



Source: Adapted from IBGE - Innovation Survey - PINTEC.

However, although the aggregate increase between 2008 and 2017 is 2.3 points
In terms of percentages, between 2014 and 2017 there was a reduction of 9.37 percentage points.
Among the reasons associated with this decline, the most notable are the spending caps on education and healthcare.
established in 2016, during the Michel Temer administration, as well as the closure of some
Interorganizational cooperation.

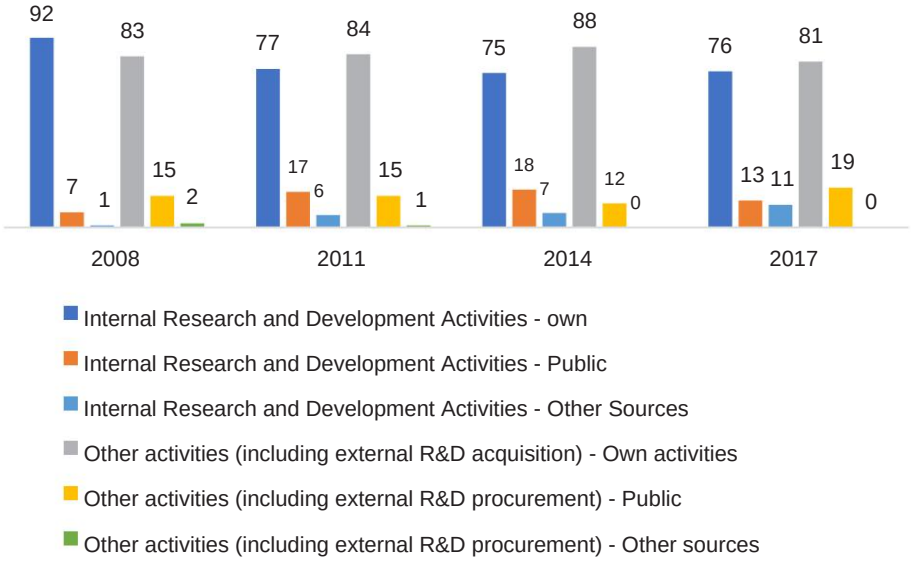
Another result that deserves highlighting is the proportion of companies that
They implemented product and/or business process innovation and maintained cooperation.
with universities, especially for R&D and product testing. It is observed
Continuous and successive growth, without reductions, totaling an increase of 35.49 points.
percentages for the period from 2008 to 2017.

This behavior indicates the effectiveness of the set of policies aimed at
Business-university interaction. According to Holanda (2017), companies gain access to
highly qualified human resources reduce costs and risks in R&D; in turn,
Universities broaden the practical experience of researchers and strengthen their image.
institutional recognition adds prestige to scientific work.

To make these innovations viable, funding sources are crucial.
which may involve either own resources or public funds. Graphs 06 and 07

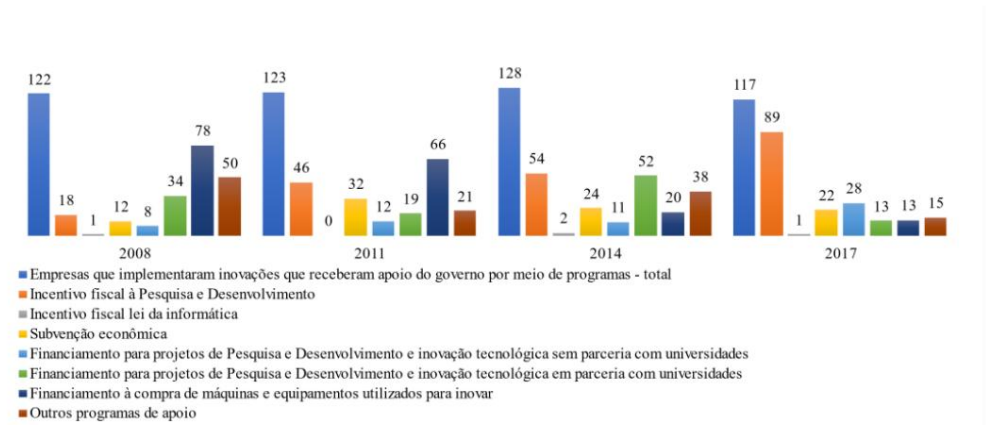
They present, respectively, the sources of funding (public and private) used and the Companies' participation in financing programs.

Chart 06 - Funding sources used by companies, in percentage, in Brazil between 2008 and 2017



Source: Adapted from IBGE - Innovation Survey – PINTEC

Chart 7 - Financing programs used by companies in Brazil between 2008 and 2017



Source: Adapted from IBGE - Innovation Survey - PINTEC.

Reading Graph 06 allows us to identify a preference for financing with own resources for internal R&D activities and other activities. Even so, There is a slight increase in third-party funding, especially public funding, which suggests Greater confidence in external investments, especially those of public origin.

SCIENTIFIC ARTICLE INNOVATION_Suggestion…

Graph 7 complements the analysis by highlighting the growth in the number of Companies benefiting from government programs supporting innovation. Between 2008 and In 2017, participation increased from 38.75% to 66.18%, totaling a variation of 27.43 points. percentages, mainly associated with the expansion of the reach of programs and policies. public.

SCIENTIFIC ARTICLE INNOVATION_Suggestion…

Also shown in Chart 7 are tax incentives for R&D, which showed strong growth: In 2008, 5.71% of companies used this benefit; in 2017, this figure rose to 50.46%, representing... An increase of 44.75 percentage points, making it the fastest-growing mechanism. during the period and reinforcing its role in expanding the capacity for capital allocation in innovation.

SCIENTIFIC ARTICLE INNOVATION_Suggestion…

Also noteworthy is the relationship between the number of companies benefiting from Government funding for R&D and technological innovation projects, with and without university partnership. In the case of projects in partnership with universities, there was growth between 2008 and 2014, of 13.59 percentage points (relative to the sample of each (year), followed by a drop of 16.95 percentage points between 2014 and 2017. These results They reiterate the interpretation that the 2016 spending cap had an impact. The incentives for business-university cooperation are negatively impacted.

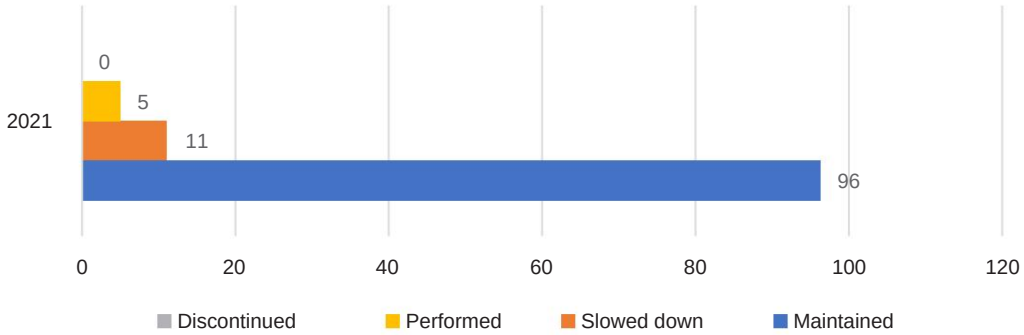
In the case of projects funded without partnerships with universities, the participation of The number of companies benefiting from this program grew by 13.1 percentage points between 2008 and 2017. Together with Given the growth in university collaborations observed previously, it can be inferred that... Companies are increasingly recognizing the importance of these partnerships, as evidenced by the growth of initiatives. without government incentives suggests direct actions from companies and universities, with Allocation of own resources to innovation projects.

In line with this evidence, Pinheiro, Rapini and Paranhos (2021) They analyze economic subsidy resources allocated to the pharmaceutical sector and indicate that Policies initiated in 2001 were continued in 2008 through the Development Policy. Productive (PDP), and in 2011, through the Programa Brasil Maior (PBM), with the participation of FINEP. According to the authors, such programs were relevant to the growth of the sector. recognized as strategic in these policies. These elements help to explain the growth of companies benefiting from economic subsidies: between 2008 and 2017, the Participation increased from 3.89% to 12.51%.

In 2020, with the COVID-19 pandemic in Brazil, a widespread crisis occurred in various sectors of the economy were affected; however, the pharmaceutical sector did not show any impact. Critics comparable to the others. Graph 08 presents, for 2021, the situation of activities of companies that have implemented product and/or business process innovation In light of the effects of the pandemic.

According to Graph 8, none of the companies in the sample discontinued operations. planned, which stands out because, even in a crisis context, the full maintenance of Planning demonstrates the sector's ability to adapt to unforeseen events.

Chart 08 - Status of activities carried out by pharmaceutical and fine chemical companies that implemented product and/or process innovation during the COVID-19 pandemic in Brazil in 2021.



Source: Adapted from IBGE - Innovation Survey - PINTEC.

According to Chart 8, only 11 companies slowed down their activities. While 96 maintained the planned activities and 5 developed new activities, in a sample in which 112 companies implemented product and/or business process innovation. These The data reinforces the essential nature of the sector, even during times of crisis.

In line with this interpretation, Reis and Pieroni (2021) present a macro analysis. of the pharmaceutical sector during the pandemic and pre-pandemic period, highlighting difficulties of Obtaining Active Pharmaceutical Ingredients (APIs), based on global demand, with repercussions on the logistics chain and on the activities of various companies. Despite Despite these difficulties, the authors note contributions from multiple organizations, both public and public. private and philanthropic.

Given this body of evidence, it can be inferred that the pharmaceutical sector has adopted... Contingency strategies were implemented during this period, while simultaneously achieving greater success. recognition of its importance, presenting itself as a fundamental sector for the society, regardless of the global context.

Final Considerations

The pharmaceutical and fine chemical sector is among those with the highest propensity. Innovative in Brazil, with the presence of disruptive innovations. The discussion The development highlights its economic and health relevance, associated with both the high market value in terms of adaptability to adverse scenarios; in this context, the The configuration and continuity of public policies are determining factors for sector performance.

In light of the empirical evidence presented, the policy retreat observed in 2016 had a negative impact on the sector, contributing to a reduction in the number of Companies that have innovated. The sustenance of innovative dynamism tends to focus on large companies, given that they have a greater capacity to invest capital in innovation. and internalization of benefits arising from these investments (Pinheiro; Rapini; Paranhos, 2021; Mascarello, 2021).

In a complementary sense, small and medium-sized enterprises are targeting primarily in the generic drug market, characterized by high demand and a profit-driven logic. by volume, more than by high margins. In this segment, the combination of Financial limitations and insufficient incentives reduce the willingness and feasibility of investments in innovation, which is reflected in the decrease in the number of firms. innovative in the sector (Capanema; Palmeira Filho, 2010; Paranhos, 2012).

Therefore, it can be concluded that, although the sector has shown progress from the perspective... Financially, there was a reduction in the number of companies developing innovations, in especially because small and medium-sized organizations have focused their efforts on pharmaceuticals. generic technologies, to the detriment of more R&D-intensive innovative activities.

As discussed, government support remains crucial, as it enables... resources and incentives capable of expanding the innovative participation of small and medium-sized enterprises companies, reduce asymmetries with the major market players and promote greater competition, with potential repercussions on the accessibility of medicines.

Furthermore, the effects of these incentives tend to be amplified by policies. that bring small and medium-sized enterprises closer to partners in the innovation process, especially universities, contributing to cost reduction and greater fluidity in technological development (Holanda, 2017). This articulation can expand the conditions so that these companies can patent their innovations and legitimately exploit the temporary exclusivity arising from intellectual property, also favoring

attracting foreign capital and strengthening the sector in the country (Campos, 2011; Reis; Pieroni, 2021).

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