Science and Technology Policy in Brazil: an Analysis of the Recent Period

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Abstract— **This paper is based on the perception that science and technology policy (STP) in Brazil has followed a steady course over the last decades, regardless of each government's particular orientation. In this sense, it has acted almost autonomous. The main objective is to analyze in what degree has the agenda of science and technology policy actually changed. In this sense, we explore this policy's trajectory, emphasizing the more recent period. Based on the evidences we found in the literature and in policy documents, we conclude that although there has been some change in the discourse surrounding STP in Brazil, the policy's agenda itself has not changed significantly. We argue that this is due to the policy makers' rationale concerning science and technology.**

Index Terms— **Research community; policy agenda; science and technology policy; Brazil**

I. INTRODUCTION

Brazilian science and technology policy (STP) is an object of study of great complexity, partly due to its characteristics as a means-policy (one that supports and permeates many others) and partly to the specificities of the peripheral context in which it is developed. The public agenda of this policy, which can be understood as its constituting core, is the product of a tension between the private agendas of various actors such as scientists, bureaucrats, firms, social movements, NGOs, the military, etc. [1].

It is from the particular architecture of power shaped by the actors who participate in the "political game" in every historical moment that public policy is shaped. Thus, science and technology policy can adopt different orientations (military-driven, economic-driven, for competitiveness, for sustainable development, for social inclusion, etc.), so it reflects precisely the result of this "game".

Like any public policy established within the framework of the "modern capitalist state" [2], STP serves primarily the interests of a few social actors. In Brazil, the research community (or the "scientists" as some authors put) is the dominant actor in the decision making process that is in charge of the construction of the national STP agenda. This means that their interests are almost entirely reflected by this public policy's agenda.

The rationality behind science and technology policy, as suggested by international evidence, has been supported since the 1950s by the ideas presented in the famous report *Science: The Endless Frontier*, prepared by the director of the American *Office of Scientific Research and Development*, Vannevar Bush, and presented to US President Henry Truman in 1945 [3, 4].

The report carried most of the aspects of the "linear" approach to the relationship between science, technology and development in later decades. In particular, the notion that there could be no progress without scientific and technological advances appears clearly in the text produced by Bush. The idea that the state would be in charge of promoting those research activities is another point clearly pointed out by the report.

Over the six decades that have elapsed since the development of this report this notions, which have shaped the rationale of research communities all over the world, has influenced and legitimized most of what has been done in terms of science and technology policy, both in developed and developing countries. Besides, it has also favored this particular actor – the research community – on several occasions.

Accordingly, an analysis of Brazilian science and technology policy indicates that the research community plays the role of dominant actor in the agenda-setting process, and has done so since the moment of this policy's institutionalization [5]. This fact explains, to a large extent, the relative continuity of the actions implemented under different administrations, something that seldom happens in other public policies, especially in Latin America.

The analysis of the behavior of the actors involved with the development of science and technology policy in Brazil since the time of its institutionalization highlights the political and ideological aspects present in the policy-making process. To

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explore this dynamic over the course of the last few decades is our objective here.

This paper is divided in four sections, besides this introduction. The first two ones present a brief description of the trajectory of Brazilian STP, especially in the last few decades. The third section focuses on the policy makers' rationale as a crucial explanatory element regarding science and technology policy. The last section presents a summary of the conclusions based on this analysis.

II. A BRIEF HISTORY OF BRAZILIAN SCIENCE AND TECHNOLOGY POLICY

Although the constitution of a "scientific culture" in Brazil refers to the eighteenth century [6], its effective institutionalization occurred in only half of the twentieth century. According to Motoyama, the surge of industrialization Brazil went through in the 1930s created a need for modernization of the administrative apparatus, as well as for instruments of governmental action. To meet this need, universities and research institutes were created, adjusting the science and technology (S&T) system to the needs of the productive sector.

According to the author, "[i]n fact, in the 1930's, Brazil went through a modernization process, albeit late. The breakdown of the oligarchic society of the coffee barons opened the doors to new forms and social structures under the aegis of modernity. Following this, there would be cultural, scientific and technological transformations" [7: 254, *our translation*].

It is in this context that universities were created in São Paulo (University of São Paulo) in 1934, and in Rio de Janeiro (University of the Federal District) in 1935. Both universities would join in the efforts of laboratories and research institutes already established in the country. However, their role would differ from other already established institutions: while research institutes such as the Campinas Agronomic Institute (founded in 1887) and the Institute of Experimental Pathology in Manguinhos (founded in 1900 as the Federal Institute Serotherapy) were primarily set up to conduct "applied research", the new universities were originally organized with the purpose of conducting activities related to "basic research", going against the pragmatism of the political authorities of the time.

Thus, the creation of the new universities represented a first impulse to respond to the growing demand for qualified professionals in Brazil, especially in industry, agriculture and public administration. On the other hand, however, the surge of industrialization had little impact on Brazil's technological capabilities. That is to say, although the country had managed to achieve a considerable transformation in its productive structure, the constraints of a peripheral economy, such as the concentration of income and wealth, low wages and the atrophy of the domestic market still lingered.

The period prior to the 1950s was also marked by the creation of state institutions that had a relevant participation in the establishment of the foundations of Brazil's STP, especially during the first Vargas government (1930-1945). Examples include the General Board (later National Department) of Mineral Production, created in 1933 under the supervision of the Ministry of Agriculture and responsible for conducting research related to mining activities; the Institute of Technology, also created in 1933 and linked to the Ministry of Agriculture; and the Institute for Technological Research (IPT), under the supervision of the Polytechnic School of Sao Paulo, and replacing the Materials Testing Laboratory in 1934. These actions were inspired by experiences adopted in the USA, in Germany in the UK and in the USSR [7].

Naturally, such initiatives, through which the foundations for the institutionalization of science and technology policy were set in Brazil, were not only based on the needs imposed by the surge of industrialization of the 1930s and 1940s or the unilateral initiative of the Vargas Government. Even then, while the Brazilian research community began to emerge, a coalition of academics was already advocating for state support to scientific and technological development.

Among the main actors involved in this process were the Brazilian Association of Education (ABE) and the Brazilian Academy of Sciences (ABC), which performed a similar role to the one that would later be played by the Brazilian Society for the Development of Science (SBPC), established in 1948 [8].

These actors had a key role in settling the rationality of S&T policy in Brazil, in outlining the standards to be observed by it and in legitimized the measures undertaken under STP to society as a whole. According to Morel, "science at that time "became part of the political discourse, and a series of measures were taken to make it more productive, more effective. Science was valued for its character as a productive force, being able to create technology and also promote capital accumulation by large business units" [8: 70, *our translation*].

The 1950s is generally acknowledged as a defining moment in Brazilian history. They represent a time of accelerated modernization of the country's productive structure and the overcoming of a primary exporting model by another, supported by modern industry. The Brazilian government acted proactively in order to create the basis for the country's heavy industrialization phase, so that it actually became a reality, although later interrupted [9]. Actions such as the protection of emerging industries, the support for domestic and foreign private investment and the creation of public enterprises in strategic industrial sectors were at the center of this project.

The transformation of the productive structure in Brazil during the 1950s is evidenced by a substantial change in the profile of the country's industry. Especially during Juscelino Kubitschek´s government (1956-1961) the production of technological dynamic capital goods and durable consumer goods increased significantly.

It was based on this foundation that Brazilian STP was actually institutionalized in the early 1950s. The main milestone in this process is the creation of two important institutions in 1951: CAPES (Campaign for the Improvement

of Higher Education Personnel, later renamed the Commission for the Improvement of Higher Education Personnel) and CNPq (National Council for Scientific and Technological Development).

CAPES' mission was to expand and consolidate post-graduate studies in Brazil; CNPq's was to support research activities, particularly in the field of physics. The creation of these two institutions expressed the state's recognition of the importance of scientific and technological development as part of a national development strategy and signals the sets the role of the state as a systematic supporter of scientific and technological activities in Brazil.

Inserted in Brazil's modernization project, the genesis of CAPES and CNPq synthesized the view that the development of science is an absolutely necessary condition for national development. This was, in a way, derived from the rationale that enveloped STP in developed countries following WWII. International organizations such as UNESCO, the Inter-American Development Bank IDB and the Organization of American States (OAS) played an important role in channeling this rationale, which was quickly embraced by the Latin American research communities [10].

This rationale is clearly expressed by Vannevar Bush's *Science: the Endless Frontier* report. It was precisely this rationale that allowed scientific and technological activities to receive systematic attention by the governments of several countries during this period [3, 11]. In other words, this was the factor that assured the maintenance (and, often, expansion) of public resources devoted to science and technology during the following decades.

Perhaps the triumph of this rationale, despite the resistance of various social groups [4], had only been possible because of the prestige enjoyed by the research community since after WWII and of the strengthening of the technological culture since then, which contributed to the gradual dissociation between science, technology and society [11]. These two factors made it possible to the research community to displace other actors in the "political game" allowing their own interests to prevail.

It is not surprising that this rationale has been adopted and disseminated by scientists from all over the world [11] After all, the "model" for STP derived from it assured an increased funding for S&T and granted a great deal of autonomy to researchers, in terms of their practices and their choices of the research themes.

In this sense, the institutionalization of Brazilian STP during the 1950s must be understood not only as a reflex of the countries' modernization, but also as a product of a pressure from the research community. The establishment of formal mechanisms of state support for scientific and technological activities constitutes one of the main demands of this actor since the early 1950s. Implicitly, the Brazilian research community was not only advocating for the creation of institutions that could support S&T activities, but also for the construction of spaces that would boost its political power.

The belief system of the Brazilian research community – supported by the "endless frontier" rationale – served as a rhetoric tool capable of influencing a range of policy choices embodied, for example, in the institutional features of CAPES and CNPq. It also served as a way of legitimating policy choices. After all, when a significant portion of society accepts as a fact the idea that scientific and technological advancement of any nature is not only desirable but also absolutely necessary to ensure progress and welfare, any action that presents itself as a guarantee of progress tends to be legitimate.

The Military Coup of 1964 was a turning point in Brazilian political history. It was also an important milestone for the country's science and technology policy, in which the characteristics of the "developmentist" project of the military regime were quite evident. Some fields of knowledge, such as nuclear physics, petrochemicals and engineering materials, which were little explored in Brazil until then (even in comparison to other developing countries), received more attention, that is to say, more resources.

Naturally, the research community was, like other segments of Brazilian society, a victim of censorship and repression during the military regime [12]. However, the perception that scientific and technological knowledge is essentially neutral, shared by the military regime, allowed the research agenda to remain relatively stable over this period. Nevertheless, as illustrated by Bautista Vidal's account [13], there were moments in which part of the research community openly challenged some actions from the military regime.

Although scientific and technological development has represented an important strategy within the developmentist project of the military, it is noteworthy that the volume of resources allocated to the area of S & T during the period of the military regime (1964 -1985) varied considerably [12]. This was not, however, the result of a similar shift in the perception that the military had about the importance of science and technology within its project. It was only a reflex of the uncertainty, instability and economic crises that were common during this period.

A process of bolstering scientific and technological research as a tool to support national development began during the Costa e Silva administration (1967 - 1969), in which CNPq, in particular, served as a strategic institution. This movement was supported by the Three-Year Plan (1968-1970), in which S&T occupied a key position as instruments for accelerating national development.

Indeed, it was only from 1967 that science and technology began to gain prominence in national economic programs, being incorporated into the governmental discourse as an increasingly important legitimizing element for the military regime's project, and also in the Federal Constitution of 1967, establishing the state's duty to encourage both research and teaching of science and technology (Article 179).

Brazilian STP during the military regime was inserted in what Velho & Saenz [14] dubbed the "military regime's project of technological autonomy", which aimed to create conditions for developing national technologies in order to answer to the demands of the local productive sector.

Again, areas such as physics and chemistry were emphasized. Agriculture, energy and aerospace industry were some of the sectors that benefited from the key position S&T occupied in the national development strategy during the

military regime. The support given to these areas during this period explains the current comparative advantages Brazil currently holds in the production of agricultural goods (through the support of Embrapa), in underwater oil drilling (through Petrobras) and in the production of small-sized civilian aircrafts (through Embraer).

The nationalist spirit of the Brazilian military government acted as a powerful social binder around the idea that the desired technological autonomy would be achieved. According to Velho & Saenz "[t]he context of political, economic and social development in the 60s and 70s showed: an authoritarian government that had come to power with the military coup of 1964, surging and easy access to international credit, easy access to developed technologies; exceptional growth of the economy; increasing demand for qualified professionals. These elements constituted an artificial "national consensus" about the idea that the country could become a significant actor in the international arena and enable the project "Brazil great power" of the military " [14: 23].

Some of the main actions of the military government in order to promote the so coveted technological autonomy involved four main sets of actions [14]:

i. Protection of the still fragile domestic industries through market reserve in strategic sectors;

ii. Creation of state owned companies and support institutions in strategic industries;

iii. Higher education reform (in 1968) and

iv. Establishment of special funds aimed towards promoting scientific and technological activities.

These actions illustrate some of the complexity developed by Brazilian STP during the period stretching from 1964 to 1985. In this sense, one cannot ignore the role of the country's research community as an important coalition that advocated precisely for the creation of new institutions, for the expansion of funding mechanisms and for a greater attention to be paid by the state to some disciplinary fields. Thus, during this period, one can plainly observe the "endless frontier" rationale at work in Brazil, following similar processes in many other countries [3].

It also must be noted that the research community had and still has a central role in setting the agenda for STP in Brazil. This actor has been particularly successful in shaping "explicit" STP (or the "discourse level") in order to muster the support of several others, notably politicians, bureaucrats and, evidently, the military, during the period of the military regime [15].

The end of the military regime represented a period of great political euphoria. Several groups of different ideological orientations postulated to set, each with their own political project, the first lines of the new democratic history of Brazil. The product of the tension between these different proposals eventually materialized a few years later as the 1988 Constitution.

Complications associated with the regime change, of course, were common. In fact, Brazilian democratic experience was still very limited. State institutions, political parties and society as a whole would have to learn to operate under a new set of rules and practices. The perspectives for Brazil's future as a democracy, however, then outweighed any drawbacks associated with such lack of experience.

If the political environment of the late 1980s was favorable, the Brazilian economy, facing constraints and uncertainties imposed by the "debt crisis", was in absolute turmoil. In this context, structural transformations in the economy, or even the upkeep of the GDP growth rates of previous decades, would prove to be virtually impossible.

The characteristics that marked the late 1980s, making it a unique period in the history of Brazil, were economic stagnation and uncontrolled inflation. These conditions compromised the country's own political capacity to respond to internal and external challenges. This situation eventually led to a symbiotic relationship between economic stagnation and financial parasitism during the late 1980s and early 1990s [16].

The Brazilian model of growth from the 1980s may be labeled as an "unstable growth model of low dynamism" [17]. Among its main features was a high volatility of the product combined with a low average growth rate, characteristics which were also common (if not even more severe) in other Latin American countries.

The economic restrictions to which Brazil was submitted during the "lost decade" (the 1980s), combined with the political turbulence of the democratic transition of that period, are elements that should not be ignored when analyzing Brazilian science and technology policy in this period. The context of hyperinflation, coupled with the constraints associated with foreign debt, imposed severe restrictions for the strategies that could be adopted in terms of STP, as well as on other policies [18].

Finally, it is noteworthy that since 1985, there were some important changes in the Brazilian national development strategy, which became heavily based on attracting capital in the form of foreign direct investments and imports of machinery and equipment as a path to modernize the national productive structure. These changes had significant impacts on Brazilian STP. The most important one is related to its agenda, which would from then on include topics such as the attraction of foreign capital in technology intensive sectors, measures to reduce protectionism in emerging industries (such as the reduction of import barriers), formal mechanisms for protecting intellectual property, etc [14].

The somewhat belated creation of the Ministry of Science and Technology in 1985 is, however, an event of great importance, especially in that which regards the political and institutional organization of Brazilian STP. It was the result of the mobilization of members of the research community who referred to President-elect Tancredo Neves the proposal for the new ministry. Neves embraced it and it was implemented by Sarney (the Vice President-elect, who would become the President following Neves' death prior to his inauguration). The Ministry has since become a key player in the country's STP, formulating policies and programs, reviewing resources, and coordinating the actions of other institutions.

Motivated by a desire to equal the Brazilian S&T indicators to those of the USA and of the lead European countries, the Ministry implemented the "Technical Training for Industry

Support Program" (PACTI) in 1992, which structured old and new policy tools around the axis of university-industry relations. From the mid-1990s – and, in particular, during the first FHC (Fernando Henrique Cardoso) administration (1994-1998) – the Ministry of Science and Technology begun to forcefully stimulate private R&D efforts and the cooperation between firms and public universities and research institutes, in order to raise the level of private spending on research in Brazil to that of the developed countries [14].

The pattern that has since then shaped university-industry relations has been dubbed "supplyist", since it is based on the "supply of knowledge" by public universities and research institutes, rather than on the "demand" by the productive sectors (with the notable exception of companies such as Petrobras, heavily fostered by the state) [5].

This pattern has been pointed out as an evidence of the research community's influence over the policy's agenda [14, 5]. In an attempt to secure new sources of funding for research in a context of the shrinking of the state due to the neoliberal pressures, public universities and research institutes have turned to the private productive sector. Most of the Brazilian companies, however, seem to place little importance on partnerships with universities. According to PINTEC, a broad national innovation survey, 67% of innovative firms declared that cooperation with universities were of little or no relevance at all to their innovative activities. Only 21% of innovative firms qualified these partnerships as highly relevant [19]. This may also be considered evidence that the supplyist approach to university-industry relations in Brazil seems to be rather one sided, benefiting the research community more than it does the productive sector.

One aspect of note is the particular competence shown by the Brazilian research community in capturing certain elements of discourse and using them as means of legitimating the adoption of the supplyist approach. Viotti highlights the importance conferred to elements such as "entrepreneurship", "business incubators" and "technology parks" by Brazilian S&T policy makers. The now common use of these terms is in fact directly linked to a fundamental aspect of Brazilian STP that dates back from the 1980s: the emergence of technological innovation as a fundamental objective of this policy [20].

The discourse of technological innovation has since become consistently stronger in Brazil. This is fairly clear, for example, in the very document that established the Technical Training for Industry Support Program. Naturally, the term "innovation" was already present in earlier documents. However, it was not a policy core element. Nor was it stressed as an absolutely necessary condition (and in some cases a sufficient one) to promote economic and social development, as has become since the early 1990s.

III. BRAZILIAN SCIENCE AND TECHNOLOGY POLICY IN RECENT YEARS

A more recent development that also illustrates this shift in the discourse of Brazilian STP was the institution of the Industrial, Technological and Foreign Trade Policy (PITCE) in 2003. PITCE had the explicit goal of "encouraging to change the competitive standing of the Brazilian industry based on differentiation and product innovation" [21: 83, *our translation*].

The document containing the general guidelines that would later be incorporated into PITCE emphasized that the horizontal axes of this policy would be, in addition to the innovation and technological development, the insertion of the external economy (through international trade competition) and industrial modernization.

In this sense, Arruda, Vermulm and Hollanda stated that PITCE would be essentially different from the policies of the 1960s and 1970s, focusing on the development and expansion of industrial bases in the country, and also different from those of the 1990s, whose focus was the stimulating competitiveness [21]. In fact, the differences among the PITCE and "developmentalist" policies of the 1960s and 1970s are very significant to be disregarded. However, we believe that PITCE is not sufficiently distinct from the policies of the 1990s in its essence. The focus on technological innovation represents a refinement of the ambiguous focus on competitiveness rather than a consistent change in policy paradigms.

Although the shift towards "competitiveness" and "innovation" in the policy discourse level dates back to the mid 1980s, it was only in the mid 2000s that it began to consistently permeate S&T policies. Two laws that were sanctioned by the National Congress during this period effectively consolidated innovation as a main element of Brazilian STP: Law nº 10.973/04 ("the innovation law") and Law nº 11.196/05 ("the law of good").

As its name indicates, technological innovation occupies a central important role in the innovation law. It also shows other features common to the trajectory of Brazilian PCT, as the deal, the argument of the importance of partnerships between universities and business companies, besides the focus on high technology

The law of good, in turn, represents an important addition to the Innovation Law, whose characteristics overly broad would add little in terms of operability to the legislation. It has been criticized, besides, by supporting only those companies with system calculation of real taxable income. That is to say, in practice this law benefits the large companies (often the one with foreign capital) to the detriment of those small and medium business ones.

Based on the analysis of policy documents and evidences of their application, it is clear that, despite some major changes (being its "privatization" the main one), there is little difference between the general characteristics of Brazilian STP in the post-1985 an those from the earlier period (1950-1985). Thus, it is noteworthy that this policy has been marked by its continuity through successive governments, something unusual among the set of public policies within the Latin American context.

From the military dictatorship to the democratic renewal, from conservative to progressive governments, the core of Brazilian STP policy has surprisingly preserved most of its core aspects. Legitimized by both the discourse of rationality

and the research community, they have, as we argued, benefited this actor significantly, ensuring their access to public resources, and large portion of autonomy.

The "privatization" of the PCT in course since the mid 1980s, however, represents an important new element, which was enough to qualify as a new pattern, different from the previous one. There was no paradigm shift, though: rather, this represented a new phase within the same paradigm.

The national development bias that influenced Brazilian scientific and technological policy until 1985 was displaced by a managerial rationality. But the research community still remained as the dominant actor behind his policy (one could say that, in some cases, this position was even stronger).

Especially since the 1980s, the research community's discourse began to incorporate as its central element the idea that technological innovation is the main engine of economic development. It also has since then greeted the private company as the privileged locus for the generation of such innovations. Implicitly, however, Brazilian STP has long overlooked the demands of companies, which were not concerned about R&D inner activities, but rather with mechanisms that would allow them to import foreign equipment at lower costs. As Viotti argues, this has been the dynamics of the Brazilian "Passive Learning System" (as opposed to the "National Innovation Systems" of developed countries). Brazilian companies have historically learned how to operate foreign technologies without building the skills to later develop similar ones [22].

The shift in the discourse level, however, is not a trivial thing. The importance given to technological innovation and to the role of private companies, at first only a strategy for legitimating the privileged position of the Brazilian research community, has actually become part of this actor's rationale. The business needs and demands are increasingly addressed by the scientific and technological policy, as indicated by the emphasis on the newly created mechanisms for tax waivers guaranteed by the innovation law and the good law. The presence of representatives from the business sector is also increasingly common in areas where STP is debated.

The political meaning of these changes must also be made clear. The introduction of innovation as an aspect of nuclear scientific and technological policy in this period was only possible, according to Viotti, because it is not necessarily conflicting with some of the basic neoliberal principles, such as free enterprise and entrepreneurship [20].

In fact, the very concept of innovation, inherently linked to private profit, is very adherent to that discourse. This aspect, however, has been masked by the widely accepted notion of technological innovation as the main force behind economic and social development. In this sense, the consensus built around this idea is not so different from the "science frontier" argument that legitimized STP actions from the mid 1940s.

As it has been historically benefited from the "supplyist model", within the scientific and technological policy, the Brazilian research community did not ally, at first, with the advocates of innovation [5]. Probably because it instinctively realized that the "focus on innovation" was in conflict with the "focus on academic research", meaning that, up until the

1980s, a shift towards innovation could have meant the scattering of research funds between different arenas. This tension was solved only when the concept of innovation was effectively captured by the research community and became viable within its political project.

The nationalist project of technological autonomy of the 1960s and 1970s, in which the state and public research institutions played a central role came to be replaced by a model in which private companies were seen as the central actor. Common terms were replaced by new ones: "technological change" by "innovation"; "endogenous technology production" by "international competitiveness". In this new context, the concept of innovation has been treated as a true panacea, the solution to all social and economic problems in Brazil.

The changes observed in the Brazilian scientific and technological policy point out, generally, to the growing importance of purely economic factors in the formulation, implementation and evaluation of these policies, which ends up distorting their broader goals. Innovation as a self-contained goal, as it has been treated by STP, is far from being a force that would lead to social and economic development. Rather, it has in most cases become a tool through which the research community has been able to preserve its control over the agenda.

It was to be expected that under the Lula Administration – which marked the ascension of the Worker's Party to the Presidency – would bring a shift to this logic. A number of researchers, STP "think thanks" and worker's unions greeted this as a golden opportunity to shaping a different pattern of science and technology policy, one that would actually place knowledge production at the service of the poor.

This, however, did not happen. What did happen was that Brazilian STP preserved the same pattern of the 1980s and 1990s. Innovation for competitiveness was still the core element of the policy's agenda. In the following section we explore some of the possible reasons behind these tendencies.

IV. THE RATIONALE OF S&T POLICY MAKERS

In this section we introduce some of the foundations of policy makers' views concerning science, technology and society relationships, which is in the very core of STP's rationale.

The rationale may concern a social actor (or group of actors) or public policies as a whole. In situations in which the architecture of power favors a specific actor, they may try to inflict their cognitive model on others. Being successful in this attempt, they will impose their cognitive model over the policy model. This is what happens, for example, in the case of STP. The hegemonic actor (academia) translates its own cognitive model into the policy's model. Perceived as legitimate, that actor's view concerning STS relationships becomes highly influential and is also incorporated in the cognitive model of other policies, such as SIP, industrial policies, agricultural policies, etc.

In this sense, in order to understand some of the characteristics of Brazilian STP (and, in particular, its inadequate interaction with SIP) it is necessary to explore some aspects of policy makers' views on this subject. That implies analyzing academia's views on STS relationships.

The socially accepted view understands science as the pure representation of an objective truth, thus being superior to other forms of interpreting reality, such as religion, myths, traditional knowledge, etc.

If all these forms of understanding reality were different lenses that lead to different interpretations, science would be, in agreement with the common sense, the only crystalline lens that would allow the visualization of the objective truth without any distortion. The mechanism that would guarantee the execution of that noble task would be the scientific method. Given the purity of the method, the result of any experiment would be the objective truth.

Concerning technology, it is important to note that, during the last decades, the borders between science and technology have been assuming less and less clear contours, making the separation of these two objects almost an analytic formality (that we will adopt in this work with that exact purpose). In fact, it has been observed that science is becoming more and more technological, and that technology, in its turn, is becoming more and more scientific [23].

The understanding of STS relationships that shapes academia's (and STP's) cognitive model reflects the instrumental view of science and technology, conformed to by the alliance between the conception of science and technology and the recognition of the possibility of human control over them [24].

The idea of neutrality assumes that S&T are absolutely independent of social conditions or, more specifically, of social values (political, cultural, ideological, economic, etc.) associated with the context in which they are constructed. It is as if scientists, when entering a laboratory, left all of their values and interests on the outside.

The instrumental view combines that conception with the idea that technology can be fully controlled by society. Science and technology are thus understood as mere instruments capable of allowing the creation of a better society, if only knowledge is used ethically.

The instrumental view seems to be accepted thoroughly by academia, as well as by society as a whole. Surpassing this naïve understanding seems to be fundamental for rethinking science and the technology and their relationships with society.

Sarewitz presents five myths, of positivist inspiration, that might sustain such an idealized understanding of S&T [3]:

1. the myth of infinite benefit, based on the belief that more science and more technology unavoidably lead to an increase of society's well-being;

2. the myth of free research, according to which any line of reasonable research directed to the understanding of fundamental processes of nature will render benefits for society, as will any other scientific research;

3. the myth of responsibility, that states that the mechanisms of quality control in scientific research (i.e. peer review) ensure the main ethical responsibilities of the research system;

4. the myth of authority, harnessed to the conception that scientific information offers a strictly objective basis for the resolution of political disputes;

5. the myth of autonomy, regarding the idea that knowledge generated at science's frontier would be autonomous of its practical social consequences.

In fact, it is noticed that the "common sense" view is indeed much harnessed to those myths. Science and technology are generally seen as fundamentally positive forces, instruments that celebrate the submission of nature to the human genius and indispensable elements for humanity's progress.

However, there are no concrete reasons to piously accept this "essentialist and triumphalist" conception of science and technology [25]. To blindly accept this view seems to be a mere act of faith. The irony, here, resides in the fact that faith – the mechanism that would guarantee the purity of religious "knowledge" – is attacked so hardly by some of the defenders of the scientific method, the mechanism that would, in turn, guarantee the purity of scientific knowledge.

As a result of the consolidation of that view, especially during the last decades, a paradoxical picture was conformed: on one side, S&T are increasingly important elements that sustain contemporary societies; on the other, a critical understanding of the role that these elements exercise on societies is still lacking. Thus, while social actors represent users and shapers of S&T, they are still passive to that process. This paradoxical picture constitutes Winner's notion of "technological somnambulism" [26].

As the progress of science and technology is understood as an inherently beneficial process for society, STP assumes a "laissez-faire" character. Policy makers assume the attitude that stimulating S&T progress will inevitably lead to social and economic progress.

The history of Brazilian STP shows that these elements have always been present in the cognitive model of the national research community. Two of the country's main research funding agencies, the National Council for Scientific and Technological Development (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES), both founded in 1951, clearly translate the main elements of this cognitive model.

CNPq and CAPES are noted for historically having a reasonably large and stable budget and have been credited (quite correctly) as important actors in the promotion of Brazil's relative success in science outputs (measured, for example, by the number of articles published in indexed journals), which overshadows the country's results in the field of technology (measured by the number of patents granted).

Despite their importance, the programs conducted by these agencies are seldom evaluated. This is due to the widespread belief that scientific and technological development is a goal that must be pursued regardless of the cost. Although this model has been widely criticized [27, 28] and partially abandoned in many countries (in which it was noted that STP policy is just like any other public policy and, therefore, not above evaluation and social control), it still remains strong in Brazil.

Since the 1990s, Brazilian STP has become closer to industrial policies and private companies. Elements such as "competitiveness" and "innovation" were incorporated in the very core of this policy [20]. However, rather than the result of a political pressure from the industrial sector, this was a maneuver by the scientific community in order to keep the agenda under its control. Being increasingly questioned about the low social impacts of its actions, this actor sought legitimacy by introducing new elements – those traditionally related to the managerial world, not the academic one – to the policy agenda [5].

Even though it may not have been initially intended, the "shift towards competitiveness" in the discourse level of STP has greatly benefited private companies in Brazil, both national and foreign, since Brazilian laws do not clearly distinguish between the two. These elements imprint a strictly economic logic to Brazilian STP, increasing its distance from socially relevant themes.

Over the last few years, these tendencies have only been reinforced. Although there has been a movement for tipping Brazilian STP in more "socially oriented" direction, little has been accomplished in this sense. The creation of a Secretary of Science and Technology for Social Inclusion under the Ministry of Science and Technology in 2004 did little to change the broader picture. This might be due to the fact that the majority of the resources allocated under the Secretary (R$ 190 million, roughly some US$ 100 million, or almost 60% of the Secretary's budget) are derived from congressional amendments motivated strictly by electoral prospects [29].

Political pragmatism and opportunism are not, however, the only causes for the lack of effectiveness of socially oriented science and technology policies. This is also due to the difficulties associated with the interaction of STP and social policies, as we have argued.

The current Brazilian STP pattern is not coherent with effective pursuit of social inclusion, as we have argued. To achieve a transformation of STP in that sense, it is necessary to rethink this policy's bases as well as the form of building science and technology. With that, it would be viable to reorient this policy to the objective of social inclusion. The convergence between STP and SIP, however, requires the employment of an alternative approach, which we have labeled "the science and technology approach to social inclusion", and which is presented in a later section of this paper.

V. CONCLUDING REMARKS

The analysis of the trajectory of science and technology policy in Brazilian allows us to answer a series of questions. Three of them, which are often left beside, are of fundamental importance. These questions are: which social actors are effectively shaping this policy? Who is being benefited by it? And what difference does it make?

Concerning the first of these questions, the evidences that we found reinforce an argument that some authors in the field of S&T Studies in Latin America have been developing for

some time: that this policy has an insular character, meaning that it is detached from the demands of the vast majority of social actors, being dominated by the research community.

In large measure, the ideological shroud that covers STP is the result of the myths that encase science and technology, usually understood as forces that inexorably drive economic and social progress and as a field that competes only to scientists and engineers.

This is not, however, the only factor that explains the insular character of the Brazilian STP. Both the political and institutional architecture on which the policy rests is, as it might be expected, a noteworthy element. This policy has historically been run by a limited number of agencies linked to the federal administration, among which CAPES, CNPq and FINEP. This policy centralization imprints a top-down system of policy making, making it more difficult to involve other social actors and eliminating the possibility of making it more pluralistic and democratic.

One also has to consider the importance of another factor that gives the Brazilian STP its insular character is related to the short experience the country has had in terms of public policy making in a democratic context. The effective incorporation of new actors in the shaping of public policies involves, after all, a learning process. Although this is already occurring in several areas and in many different ways, setting of S&T policy's agenda remains out of bounds to actors such as social movements and NGOs, whose participation is limited to marginal issues.

This statement, however, should not be understood in its strictest sense. In fact, this policy has historically ignored the possibility of working on social problems, such as, hunger, poverty, inequality, etc. But it has also evaded the demands of other social actors, including a significant portion of the productive sector, as shown by the results presented by PINTEC [19].

Regarding the second question, concerning which social actors benefit most from S&T policies, the answer is: the research community. This actor has historically been in charge of setting the agenda, creating policy tools and evaluating policy results. STP in Brazil has, since its institutionalization, been a policy shaped *by* scientists and *for* scientists.

One element that verifies the hegemonic position of the research community is the evident continuity of this policy, even in times of political and economic inflection, as in the 1964 Military Coup and even during the process of state reform. These events brought new elements to the policy, but did not alter its core characteristics. In this sense, we may claim that the discourse surrounding STP changed so that the policy itself would not have to.

These elements make it easier to answer the third of our proposed questions ("what difference does it make?"). To ensure the participation of a more diverse and comprehensive set of actors in the policy making process is an utmost commitment to true democracy.

In a country where most of the population is set apart from formal employment status and has no access to a range of basic services guaranteed by law, science and technology policies acquire a strategic importance. To widen policy goals

in order to encompass social objectives is absolutely crucial. Last but not least, understanding how this public policy is shaped is critical to its improvement, to national development strategies and to the advancement of Brazil's still young democracy.

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