

Researchers' perceptions on university-business relations in Brazil*

Sonia K. Guimaraes

Federal University of Rio Grande do Sul
sonia21@ufrgs.br

Regis L Barcelos

Federal University of Rio Grande do Sul
rgbarcelos@gmail.com

Abstract

The article focuses on university-business partnerships. Data were drawn through electronic questionnaires answered by researchers from eight Brazilian universities (from the South and Southeast regions) and by firms that set up partnerships with academic researchers. Semi-structured interviews were also conducted with a sample of researchers who responded to the questionnaire. Among our findings, we highlight a) changes in researchers' perceptions on university-business relationships, evaluated as positive, contrary to the predominant views of the past; b) the firms we researched expressed satisfaction and interest in continuing to collaborate with universities researchers. Nonetheless, most of the companies sought out partnership in order to solve immediate problems, which does little to raise technological levels of production. Our main conclusion is that although the institutional context is not an unfavorable one, there are still obstacles that get in the way of more fruitful partnerships, such as the low technological levels of most Brazilian firms, excessive bureaucratization of procedures in public universities and lack of academic incentives to researchers involved in knowledge transfer with the productive sector.

Keywords: Brazil, university-business relations, researchers' perceptions.

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Introduction

Knowledge¹ "is assumed to be an input in production that has increasing marginal productivity" (Romer, 1986, p.1002). From this perspective, scientific knowledge becomes the true raw material and the central source for the creation of wealth. Sustainable economic and social development depends upon it, as does the solution for societies current main problems – global warming, food security, population aging, and so forth (Deiaco et al., 2012; Nowotny et al., 2003). Companies become increasingly dependent on science-based production and services. Investments in non-physical assets or knowledge-based capital (database, software, design, brands, new organizational processes and specific company skills such as human resources, people networks) are growing faster than investments in physical capital (machinery, equipment, buildings). Nearly one third of the 2017 world GDP involves knowledge-intensive technology (KIT). Furthermore, several countries – the United States, Japan, Germany and United Kingdom – stand out for their higher share of KI production and services than the world average. KI production and services, closely related to knowledge and greatly dependent on R&D activities, are present throughout the entire economy (National Science Board, 2018). Economic competitiveness became increasingly dependent on product, service or process innovation (not only radical innovations but also qualified and creative imitation).

¹ "Knowledge: a set of organized statements of facts or ideas, presenting reasoned judgment or an experimental result, which is transmitted to others through some communication medium, in some systematic form." (Daniel Bell, *The coming of post-industrial society: a venture in social forecasting*. 1976. New York: Basic Books; 1st ed 1973, p. 175 apud Castells, 1996, p. 17). The term "knowledge economy" was used in the OECD report, *The Knowledge Based Economy*, 1996.

The complexity, costs and risks of research activities and short cycle of an innovation have forced companies to seek external collaborations. Universities (and research centers) have been pressured to adapt their organizational structures, skills and strategies, breaking away from the traditional Humboldt model, which is centered on the rigid separation between academic and market interests. The trend in the reduction of researchers' access to public resources has also encouraged universities to accept partnerships with the productive sector. In this context, relations between universities/research centers and companies have grown significantly, worldwide.

As it is amply recognized, the neo-Schumpeterian perspective highlights the social and systemic character of the new form of processes of production: the company is still considered the central agent of production innovation yet becomes part of a broader system consisting of a relational network composed of different social agents and organizations as universities, research centers and companies (Freeman, 1995; Lundvall, 1992). In consequence, universities and scientific research centers face a period of change and transition, insofar as processes of scientific production have also changed: "a closer integration of the process of discovery with that of fabrication" in which "institutional differences between, say, universities and industry, seem to be less and less relevant" (Gibbons et al. 1994, p. 19, 30). There are many factors that contribute to this convergence. Some technologies, such as genetic engineering – the intervention on genes of living organisms with the aim of modifying them – have immediate commercial potential. Current social challenges are also increasingly dependent on solutions based on scientific knowledge, as mentioned above. Furthermore, innovative research is a complex, risky and costly process which demands a far-reaching collaborative knowledge base. As Mazzucato asserts "The sheer complexity and specialisation of science today means that attitudes of openness and collaboration are not a nice complement, but rather a critical factor for success." (Mazzucato, 2018, p. 5).

The interaction between universities, scientific laboratories and society – the so-called third mission of universities – is not a new phenomenon. Historians of technology showed that the relationship between the university and the economic sector is quite old: a Mathematics discipline applied to navigation was created in the fifteenth century, at the University of Venice, anticipating the economic impacts that would follow (Mokyr, 1990, *apud* Suzigan et al., 2011); in the 19th century, the industries of electricity, chemistry and pharmaceuticals had the partnership of universities and, throughout the 20th century, scientific research gave support to war industry (Freeman, 1977). Today a more intense collaboration is demanded since, to be competitive, the production process has to be less empirical and more dependent on scientific research.

University involvement in processes of economic and social development has often been criticized for alleged conflict with its traditional role. Arguments in defense of the new format state that the university autonomy is preserved and its central functions are not affected by the new attribution. It is important to consider the “two way” movement of the university-business relationship: not only does science nourish and contribute to the development of technology; the latter often precedes scientific knowledge through the trial and error method, fomenting an accumulation of empirical knowledge that, in turn, stimulates efforts of scientific explanation (Rosenberg, 1982).

Despite the need for collaboration and convergence in certain fields, universities and the productive sector remain heterogeneous organizations. Their major objectives remain intact: teaching, long term research and publishing, for academics; and applied research aiming at economic returns, for companies. However, experiences have shown that their collaboration can be successful. Relational governance that sets rules, obligations and targets, especially if established through formal contract, may contribute to partners' engagement on higher quality common achievements. Results, of

course, tend to vary according to scientific fields, university foci, organizational forms and the level of the country or regional innovative system (Casper; Miozzo, 2015). It is also important that each of these institutional actors – universities and companies – preserve their particular interests and commitments, thereby seeking a balance between independence and interdependence (Etzkowitz, 2009). Interface organizations such as technology transfer offices (TTOs) may have a relevant role to play in this process, by advising and guiding the agents through its different stages. Organization competencies may contribute to the formation of consistent relationships between researchers and external agents (business sector, development agencies, and professional communities, among others) (Gherardini, 2012; Santos; Torkomian; 2013). A study on American universities finds what has been called a “convergence towards a ‘hybrid system’...where the best universities excel in both scientific research and technology commercialization” (Owen-Smith, 2003, apud D’Este; Perkmann, 2011, p. 2).

Within the new economic scenario, where knowledge and innovation are the key to economic growth, developing countries such as Brazil face major challenges. This is particularly true for what may be seen as the “catching up” process, since new processes imply not only reproducing knowledge but an overall challenge to generate knowledge that contributes to technological development and value creation.

This article focuses on the university-business relationship in Brazil. We examine key features of these relationships, taking into consideration that a) there has been a significant growth of the number of collaborations between academic and business sectors over the last two decades; and b) since the end of the 1990s, governments have implemented a number of policies and incentives to stimulate the process of technological “catch up”, especially the knowledge transfer from researchers to the productive sector. Our discussion is divided up into two further sections. The first, on

the *Brazilian innovation environment* provides a brief description of 1) laws and incentives that provide support for technological catch up; and 2) the process of catch up itself. The second, presents our own research, examining the data that were collected and lastly, some conclusions are drawn.

The Brazilian innovation environment

As mentioned above, laws and incentives have been implemented since the second half of the 1990s, aimed at developing the innovative capacity of Brazilian companies through knowledge transfer². The policies that have guided them can be briefly summarized as follows: a) The so-called *Sectoral Funds* (1999), first legal framework for the institutionalization and development of mechanisms to support the interaction between universities, research centers and companies (CGEE, 2002; 2010); b) the *Innovate Project* (2000) aimed at financing researchers working in companies; c) the *Industrial, Technological and Foreign Trade Policy* (2003) focused on the technology-intensive sectors, aimed at bolstering their competitiveness in the foreign market, among other objectives; d) the *Innovation Law* (inspired by the 1980 United States Bayh-Dole Act), formulated in the 1990s and approved in 2004. It created legal mechanisms to favor interaction between universities and research centers and businesses, regulating the new institutional structure set up to provide support for universities, research centers and companies, including management of intellectual property, rules for the provision of specialized technical services and the sharing of public laboratories, as well as sources for innovation financing, among other goals; e) the so-called *Law of Good*

² Knowledge transfer is the process by which knowledge developed for the purpose of explaining a phenomenon is appropriated and adjusted for business uses, most often applied by companies for commercial purposes such as new products and processes.

(2005) providing tax incentives and subsidies to companies engaged in technological research, such as hiring researchers holding graduate degrees; f) the *Policy of Productive Development* (2008) focused on strategic technological areas; g) the *Great Brazil Plan* (2011) seeking to deepen earlier policies for industrial competitiveness; h) the *Business Innovation Plan* (2013), a program completely devoted to promoting innovation.

In 2008, Brazil was the country with the sixth highest rate of public subsidy for R&D expenses, behind only France, Spain, Portugal, the Czech Republic and India (Menezes Filho et al., 2014). The Technological Innovation Survey (*Pesquisa de Inovação -PINTEC*)³ (IBGE, 2016), which surveyed 132.529 innovative companies with ten or more employees (period 2012-2014) revealed an increase in the percentage of innovative firms that benefitted from government sources: 40 percent in 2012-2014, as compared to 34.2 percent in the 2009-2011 period. Nonetheless, the results of such "generous" expenditure have not been encouraging. Of the 126 economies ranked on the Global Innovation Index, Brazil was 64th, having moved up five positions regarding the previous year, yet lagging behind countries like Uruguay, Kuwait and Serbia (Dutta et al., 2018). In the eyes of certain analysts, the country's productive sector does not use all the benefits provided by the nation's science, technology and innovation system, explained by the fact that "the Brazilian manufacturing sector is concentrated in low and medium-low technology sectors and, as a result, does not demand the knowledge produced in universities and research centers." (De Negri et al., 2015, p.7).

³ PINTEC – the national survey on innovation is carried out every three years, in industry, services, electricity and gas sectors. The conceptual and methodological reference for elaborating the questionnaire is the third edition of Oslo Manual (OSLO, 2005), and more specifically, the model for the Community Innovation Survey – CIS, version 2008, proposed by Statistical Office of the European Communities (Eurostat).

Indeed, data from PINTEC 2012-2014 show poor technological performance on the part of the productive sector. The general rate of technological innovation during the 2012-2014 period remained almost the same (36%) as the previous period (2008-2011). Seventy four percent of the innovative companies in manufacturing considered that the acquisition of machinery and equipment was of high or medium relevance in promoting innovation. Among the different forms of investment in innovation, acquisition of machinery and equipment accounted for the largest amount of resources (41%, or R\$ 33.5 billion) and thirty percent of the firms resorted to government financing as the main source for the acquisition of machinery and equipment. Seventy seven percent of the innovations that were launched were new only for the companies themselves. As for investments in R&D in relation to GDP, internal R&D declined while external acquisition of R&D increased. The latter tend to be considered a more operational strategy with lower impact on long-term innovative development.

Looking into how companies judged universities and other higher education institutions as sources of information for innovation, we find that they were considered important to 46 percent of the energy and gas companies, 25.5 percent of service sector businesses and 18.5 percent of manufacturing enterprises. As for cooperation with universities and other higher education institutions, it was considered important by 82 percent of the energy and gas companies, 36 percent of service sector businesses and 24 percent of manufacturing enterprises. Thus, data show differences that are sometimes significant among economic sectors regarding the relevance attributed to scientific knowledge in producing innovation, with the lowest evaluation coming from the manufacturing sector. Data from PINTEC corroborate studies that, many years earlier, had already indicated the relatively feeble dynamics of the innovation process of Brazilian manufacturing (Viotti; Baessa; Koeller, 2005 *apud* Erber, 2010, p.21).

Our research

The sample we used was constructed from the records of research groups registered on the 2016 online database of the National Council for Scientific Research (CNPq). The CNPq is one of the two official Brazilian agencies that support scientific and mainly university-based researchers. Its online database provides information on researchers who maintain relationships with businesses. Our survey examined eight Brazilian universities located in the South and Southeastern regions of the country, the two regions which together account for 63 percent of the country's GDP. The selected universities are ranked amongst the highest performing universities in the country and account for more than two thirds of all CNPq research groups. They are also home to some of the technological parks and incubators that have been successful, such as the ones that are maintained by the State University of Campinas, the State University of São Paulo, the Catholic University of Rio Grande do Sul and the Federal University of Santa Catarina.

The data used in this study were collected through a web-based survey which, from September to November 2018 and March 2019, was sent out to the leaders of CNPq research groups from different fields, who maintained relationships with businesses. The number of researchers who qualified in this sense, within the eight universities we selected and according to the 2016 CNPq database, came up to a total of 472. The number of valid responses to our questionnaires was 123, that is, we obtained a 26 percent response rate. This rate is similar to those usually obtained in surveys on this subject that have been conducted in other countries. Face to face interviews with researchers were also carried out, aiming at exploring topics of the questionnaire in greater detail.

Our questionnaire contained questions on different topics concerning researchers' perceptions of collaborative efforts. This article presents analysis

of the following issues: a) researchers' profile; b) how collaborations began; c) researchers' motivation and objectives for engaging in partnerships; d) length of partnerships and expectations for continuity; e) researchers' evaluations of university-company partnerships (benefits and obstacles).

The first item noted above, "researchers' profile", provided basic information on our respondents' personal traits, such as age, sex and career credentials. Regarding the item, "how partnerships began", our goal was to examine the kind of arrangements that led to engagement in external collaboration. This could take shape through informal mechanisms, such as personal contacts by way of students, through initiatives originating in firms, researchers' interests or social networks. Initiatives might also be propelled by institutional entities such as technology transfer offices (TTOs), technological parks, research agencies or the result of fairs, congresses and events.

Researchers' motives for engaging in external partnership were associated with values. This might refer to "traditional behavior" oriented by the pursuit of funded research, and/or a commitment to contributing to the country's technological development. The section devoted to researchers' objectives or goals evaluates the nature of collaborative efforts, on a continuum moving from weak (restricted to solving specific problems within the firm) to strong forms of involvement (contributions to the advancement of a firm's levels of technological development and competitiveness). Researchers' evaluations concern the degree of satisfaction with the benefits provided by collaborative efforts, and employs a scale of 1 to 5.

In our sample of 123 researchers, researchers from the fields of Engineering and Hard Sciences were those who most engaged in collaborative work with enterprises, 40.0 and 31 percent respectively; Agricultural Sciences represented 14 percent of the total, followed by Biological Sciences, with 9.0 percent, and Health Sciences, 5.7 percent.

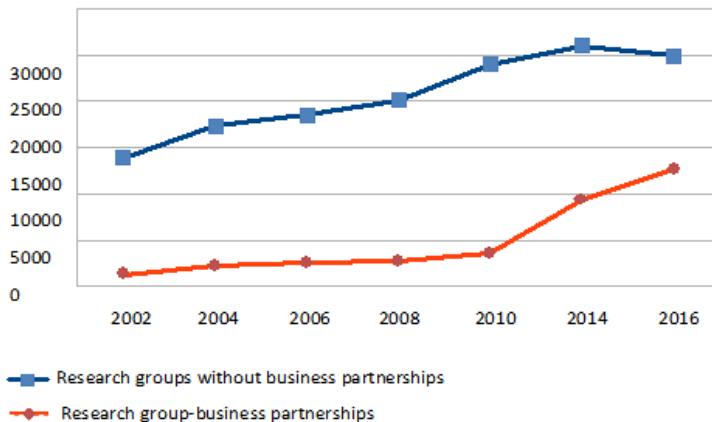
Worldwide, disciplines such as engineering and other hard sciences have a tradition of working with industry, tending to influence the academics' motivation to seek collaborative work with businesses.

The number of existing CNPq research groups experienced a reasonable increase along the period from 2002 (the year the database begins) to 2016: from 1,279 research groups, in 2002, to 9,348, in 2014, and 12,681, in 2016. Chart 1 demonstrates the evolution of research groups (from universities and research centers) registered in the CNPq database with and without external collaboration. There is a significant difference between them, revealing the fact that the great majority of academics and scientists are not responding to policy incentives to set up such partnerships. The difference between the two groups is also evident in relation to temporal nuances: there has been a steady growth of groups without partnerships since 2002, when the accounting began; groups engaging in partnerships showed insignificant growth until 2010, at which point there is a noticeable change. As of 2014, the number of groups not engaged in collaborative efforts dropped slightly, while the groups with partnerships continue to increase: while groups with collaboration made up a scarce 13 percent of the total in 2006, by 2016, they represented 51 percent.

The growth of research groups engaging in partnerships coincides with the increase in the government funding to science, technology and innovation derived from the Sectoral Funds, directly associated with incentives for university-business collaboration. The Sectoral Funds reached annual expenditures of R\$ 767 million, in 2008. The Green and Yellow Fund alone, with a budget of R\$ 48.5 million in 2001, was up to R\$ 273.7 million in 2009. The Great Brazil Plan was launched in 2011 to consolidate the national innovation system by stimulating the expansion of scientific and technological competences to companies; the Firm Innovation Plan, created in 2013, was started for the purpose of promoting innovation

within businesses. The impressive growth of groups with partnerships, beginning in 2010, might be related to the government incentives to technological development granted to the firms, considering the fact that the initiatives for collaborations came largely from business agents. The real impact of government incentives for the growth and success of these partnerships is an issue requiring more research.

Chart 1 - CNPq research groups in Brazil: a) engaged in partnership with businesses and b) not engaged in partnerships with businesses⁴



Source: Authors' organization using Research Group Database/CNPQ, 2019

Respondents' average age was 57 years old, and 75 percent were male, 25 percent female. The average age tends to coincide with a stage of career achievements: 55.6 percent of the researchers in our survey were full professors, the highest level in the structure of academic careers and 64.5 percent held CNPq grants, considered a kind of distinction for researchers

⁴ Partnerships maintained by CNPq research groups with firms (private firms, 33.0 percent; public firms, 2.0 percent) totalled 35.0 percent. Other partnerships include those with public higher education organizations (19.0 percent), non-profit organizations (11.0 percent), public sector (9.0 percent); private higher education organizations (6.0 percent) and others.

who have achieved high levels of academic production. Fifty five percent of our respondents reported being active participants in national and international research networks with other scientists. Their high levels of career and academic achievements suggest that interaction with businesses was not an impediment to high academic performance; in fact, the opposite argument can be made. Businesses are known for contributing significantly for research themes.

According to 47.0 percent of the respondents, partnerships with businesses begin largely when "sought by the company". However, the response "firm sought out the researcher" can also be interpreted as a second moment of the approach to the university, in which the starting point had been information regarding research carried out at the university provided by students or former students working in the companies regarding research carried out at the university. This was a situation reported to us by researchers who took part in the face-to-face interviews carried out by our team. Cases in which collaboration came initially from researchers "who sought out the company" were much fewer (23.0 percent), which was not surprising, given a common academic resistance to engage in exchange with the business sector. Nonetheless, almost one quarter of the researchers in our study were the party that took the first step toward a partnership, motivated by the growing scarcity of financial support for their work, especially with regard to government, which has customarily been the major source of funding for research in Brazil. But as will be explained below, another factor was researchers' shifting mindset, seeing collaboration as a way to apply their work to national development.

Regarding the importance of institutional organisms such as Technological Transfers Offices (TTOs), technological parks and incubators in initiating partnerships, we observed that only 15.0 percent of respondents recognized the intermediaries as relevant institutions in starting collaborative efforts. The relatively low participation of such

organisms did not correspond to the government policies objectives that, for instance, encouraged the creation of TTOs, on the assumption that institutional procedures would be more effective in promoting a higher quality relationship between universities and companies than informal mechanisms. The perception of low TTO participation, however, is not equivalent to denying their importance. In their evaluations of the general performance of intermediary organizations, 46.0 percent of the respondents assessed the former as positive and very positive. Evaluation of TTOs performance by itself was, in 40.0 percent of all cases, seen as positive or very positive. Discrepancy in the evaluation of intermediary mechanisms is probably due to state bureaucratic regulations, which the interviewed indicated as obstacles to the use of formal organisms for writing up contracts. In the survey, 51.6 percent of the researchers who took part in our research indicated university bureaucracy as the major obstacle to establishing partnerships with businesses ("financing resources" were the second major obstacle, referred to in 18.5 percent of all responses). A similar problem (variety and frequency of researchers' interactions with companies) was analyzed in UK, leading to the conclusion that individual competence tends to be more important than institutional mechanisms in establishing partnerships. (D'Este; Patel, 2007 *apud* De Negri et al., 2015).

Concerning motivations, most responses demonstrated a convergence with the goals of policy-makers, that is "contributing to the country's technological development"; "application of research results" and "participation in exchanges and knowledge transfers". These data suggest a shift in the academics' perceptions insofar as collaboration is no longer seen solely as a source for research funding. Researchers tend to see collaboration with external organizations as a commitment to bridge the worlds of science and technology; this runs counter to critics' fears that academic science become a mere instrument for market use. Researchers' perceptions suggest that they have assimilated the objectives and discourses

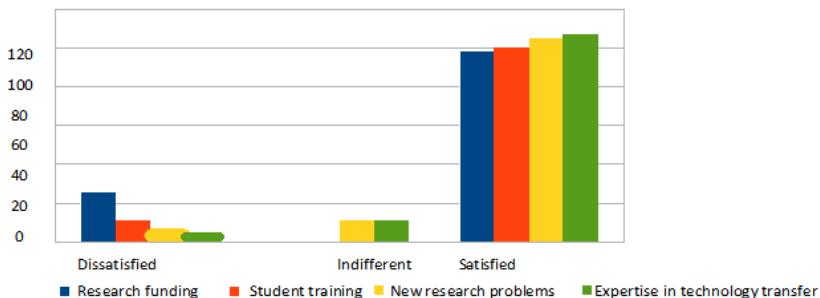
of the government policy, which advocate knowledge transfer from science to the productive sector in benefit of the country's economic development. At the same time, collaboration sought in order "to finance research" was also indicated by a high percentage (31.0 percent) of our respondents. This response does not necessarily conflict with the one referred to above; on the contrary, it may be complementary, contributing in the long run to higher levels of funding and, therefore, to better research conditions (Owen-Smith, 2003 *apud* D'Este; Perkmann, 2011).

Regarding partnership objectives, the search for "solutions for specific problems" was the goal indicated by 44.0 percent of the respondents, suggesting that a significant part of collaborative efforts were linked to weak outcomes in terms of knowledge and technological transfer to the firms. Nonetheless, taken together, all "virtuous" alternatives, such as "development of technologies" (33.3%), "research for commercial potential test" (17.0%), and "generation of knowledge" (17.0%), become the major motives underlying collaboration, converging with the intentions of policy-makers, that is, to advance the technological level of firms to benefit economic competitiveness and society at large.

Positive evaluations regarding partnership outcomes were likely to have influenced researchers' great interest in maintaining relations with companies. The totality of our respondents manifested interest in maintaining partnerships: 35.0 percent reported that the renewal of contracts was the rule; 22.0 percent reported being involved in advanced negotiation processes for the contract renewal; 22.0 percent indicated interest in maintaining collaborative efforts and had a proposal currently under analysis. Twenty per cent stated that they were interested in continuing partnership but at that moment had not received a proposal. Projects have an average duration of 24 months; 54.0 percent indicated that their partnerships had undergone no interruptions at all. The tendency of continuity in external collaboration suggests a satisfaction with its outcomes.

The variety of benefits that research groups derived from cooperation as perceived by respondents (see Chart 2), suggest they go beyond the conventional elements such as increased resources for research. Researchers pointed out that collaboration also contributed to providing new insights for future research projects, enhanced research group expertise in technology transfer activities, and created opportunities for students training. Researchers' evaluations suggested that collaborations could be seen as a two-way movement, favoring inter-organizational achievements. Again, this runs counter to critics' view that partnerships with business are potentially detrimental to academic activities.

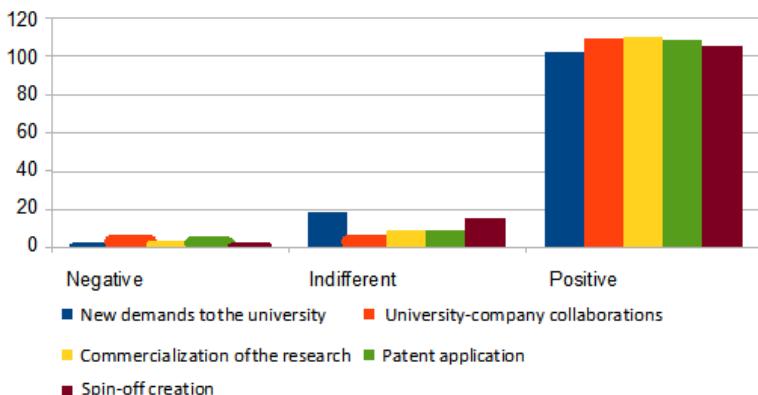
Chart 2 – Level of researchers' satisfaction with the benefits from partnerships



Source: Authors' organization using Research Group Database/CNPQ, 2019.

Researchers' evaluations on issues related to partnership with firms, in addition to generating a positive assessment on broader questions such as the emergence of new demands for the university, commercial use of research, patenting of results and creation of spin-offs, were also very positively evaluated by the respondents, as shown on Chart 3.

Chart 3 – Researchers' evaluations on collaboration with companies



Source: Authors' organization using Research Group Database/CNPQ, 2019.

Final Considerations

Our research has produced some valuable findings on the phenomenon we have studied, and provided some suggestions for the formulation of new research hypotheses. The number of CNPq research groups have as a whole increased continuously, yet the growth of the research groups with external partnerships is impressive, especially after 2010: from 13.0 percent of all groups, in 2006, they reached 50.0 percent, in 2016. This growth coincides with the increase in government incentives to companies, aiming at the technological development associated with university-business partnerships. This in turn suggests the need for inquiring into the extent that government incentives have had a real impact on policy-makers objectives, that is, technology catch up within the business sector. Although our research is unable to provide an entirely positive response at the moment, in the long run, increased university-business partnership for

research purposes tends to generate a shift in the typical/traditional culture of both actors – researchers and companies – towards their inevitable approximation.

Excessive bureaucracy was considered the greatest obstacle to establishing partnerships. To make partnerships feasible, personal and informal negotiations tend to replace the intermediation of TTOS and other organisms. This strategy conflicts with government legal regulations created to support partnerships with the productive sector that guarantee highly qualified collaboration. This is a contradictory situation. Thus, we may ask about the extent to which the excess of laws and regulations from above may limit and hinder the expansion of formal contracts that enable successful partnerships.

The researchers surveyed were senior researchers who enjoyed remarkable career achievements, a fact that in general terms run counter to critics' fears that partnerships with the productive sector impair researchers' scientific activities. Evidence has shown the opposite, that is, that the researchers who collaborate with the productive sector retain their identity as distinguished academic researchers. Critics tend to underestimate the valuable contributions to academic research that can be generated by collaboration with external organizations.

Our findings demonstrate a convergence between the ideas of researchers and policy-makers on the role of science and the country's social and economic development. But how much of this way of thinking has been concretely translated into dealing with the technological gap of Brazil's productive sector? To answer this question, further research is needed. Findings may be biased insofar as those researchers who answered the survey (about 25.0 percent of the total CNPq researchers with collaboration with companies) may be those who were most positive and enthusiastic about the subject. Nonetheless, it seems reasonable to

suppose, as we have argued above, that there is an ongoing process of change in academics' mindset on their role not only as researchers but also as social agents whose actions may benefit society at large. This is a hypothesis for further inquiry.

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