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How the “triple helix” can influence the general climate for entrepreneurs in Brazil?

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Abstract

We propose a contribution to the understanding of the new challenges concerning economic development in Brazil and more particularly on University-Government-Industry relations. This triptych, academically called “triple helix”, can be considered as a lever and motor for anchoring and developing economic investments in the territory. After having described the situation of the innovation system in Brazil, we propose to illustrate the contributions of the “triple helix” concept for two success stories in southern Brazil and explain how “triple helix” could influence the general climate for entrepreneurs in Brazil. From these two case studies, one can see the ability to promote public policies but also new innovative ecosystems as a consequence of a good enrollment and involvement in the university-government-industry relationships.

Introduction

Brazil is the largest country in South America and the fifth-largest in the world in territorial extension. With continental proportions, it extends over an area of 8,514,876.599 km². Recent researches, carried out by GEM (Global Entrepreneurship Monitor), highlights that Brazil has a total entrepreneurship rate of 38 percent that is, around 52 million Brazilians have their own business. In this scenario, of a significant improvement in data related to innovation and entrepreneurship, the collaboration emerges as a strong trend in the national business world.

It is increasingly common to open the newspaper and find data on new joint ventures, alliances, collaborative projects and gains in competitiveness achieved by small business networks. These initiatives are a reflection of the powerful “triple helix” effect - capable of influencing the entrepreneurial climate in Brazil in the most diverse ways. The relevance of government, industry, and universities for innovation is a recurring theme in the literature. According to Etzkowitz and Leydesdorff (1995), who introduced the concept of the Triple Helix, innovation would be a result of interactions between university and industry and government. Innovation is then a result of the overlap between communications, networks, and actions between the three and how, from these relationships, generate projects and strategies that add value. This brings a vision of an evolutionary and systemic process of innovation, and not as a result of a linear process pulled by demand or pushed by technology.

Based on this assumption, in this chapter, we will discuss a little about the concept of triple helix, in addition to briefly presenting the history of the evolution of the innovation system in Brazil. Finally, we will present two important cases, where the strategy that combined “triple efforts” was essential for the consolidation of a sector and the increase of competitiveness of micro and small enterprises.

The triple helix model: a new way for promoting knowledge and innovation

The triple helix model proposed by Leydesdorff and Etzkowitz (1996) was created to describe and characterize the interactions between a triptych of actors (university, industry, government) in the innovation and development process. Inspired by the biological logic of DNA, this “triple helix” proposal is a theoretical response to the increase in cross interactions between the different spheres of the helix imagined by their authors. These interactions give the first impression of the relationships between the different actors in the innovation process (Etzkowitz 2002): this implies that the knowledge base and its role in innovation can be explained in terms of changes in the relationship between universities (and all institutions that produce knowledge), industry and government (at the different level: local, regional and state). It is an alternative paradigm to representations based on the pooling of resources (cluster) for technology transfer. The interaction between academia, industry and government is seen as the interaction between the economic, social and institutional spheres, which influence policy development and the diffusion of knowledge and innovation (Saad, Zawdie, and Malairaja 2008) because the greatest innovations today would result from interactions between technology, science and the market (Tidd 2013).

At the heart of the triple helix are a collaborative network of companies, entrepreneurs, universities, research institutions and government agencies that aim to generate knowledge and innovation. This collaboration between companies, universities and research institutes reduces research costs, externalities, uncertainties, and risks. Universities are in the midst of a revolution (Etzkowitz and Leydesdorff 1997) because research is oriented towards contributing to economic development, particularly in regional territories. In addition to the two main tasks of teaching and research, universities then have the task of contributing more directly to solving practical problems for the market. The result of this new vision is the emergence of the “entrepreneurial university”, which combines teaching, research, and contribution to the economy (Campbell and Carayannis 2016).

The Brazilian context of university-government-industries relations

It is nothing new to anyone that collaborative actions between universities, companies, and governments are capable of generating surprising results, especially when it comes to technological innovation. However, in some countries, such as Brazil, actions of this nature have become more important recently. This change in the relations between the actors of the innovation system is due especially to the growing concern for the development of innovation ecosystems, based on the co-evolution of actors through collaboration. The emergence of innovation ecosystems demands the existence of well-developed innovation systems (local, regional and/or national) so that they can support the most diverse relationships and flows of resources among the actors – especially between universities, governments, and companies.

It should be noted that Brazil has a very recent national innovation system and is still in a growth stage. Studies such as those of Mamede et al (2016) highlight that it was in the 1970s that

technological development spaces started to be developed, under the context of late industrialization. However, even though in the 1990s the country had gained control of inflation and was part of technological modernization programs, Brazil cannot take advantage of the opportunities for insertion in the technical-economic paradigm that was established in the world scenario. This is due to the low volume of resources available for teaching and research, the weakness of sector financing funds, the weakness of economic policy and the flexibility of the productive base (Villaschi 2015).

Even so, the 2000 decade, was marked by relevant public policies focused on innovation: the Industrial, Technological and Foreign Trade Policy (PITCE), the Productive Development Policy (PDP) and the Industrial Policy called “Plano Brasil Maior”. Today, 20 years after the first initiatives to train the country for the insertion in the global economic interests, there are some important advances in terms of diversity of actors and greater interaction in the system of innovation. Also, during this period universities, important actors to the system changed in Brazil. Before the 1980s, university development in Brazil was based on the importation of technologies without technology transfer and therefore without entrepreneurial research-related behavior on the part of universities (Rothaermel, Agung, and Jiang 2007). Since the creation of science and technology policies and the opening of markets in 1990, Brazil has begun to understand the importance of innovation for the competitiveness of enterprises, thus enabling entrepreneurs to consider the possibility of going to universities and research institutes. During this period, the first knowledge capitalization actions (Etzkowitz 2004) began to be implemented and, since the 2000s, Brazilian universities have been preparing to become entrepreneurial universities.

The ANPEI¹ recently released a map of the Brazilian innovation system. This map shows a great variety of actors, such as public and private sector institutions, including development and financing agencies, financial institutions, public and private companies, teaching and research institutions, technological institutions, productive agglomerations, among others, whose “activities and interactions create, develop, carry out acquisitions or disseminate new technologies, with innovation and learning as crucial aspects”.

In this scenario of multiple ties, we find a set of examples of actions based on the concept of Triple Helix to produce the dissemination of public policy to promote cooperation between SMEs, FDI and/or Firms and also to foster an innovative and/or entrepreneurial ecosystem. And, for this chapter, we would like to highlight two exemplary cases, where the relationship of cooperation between university-industry and government were fundamental to influence the climate of entrepreneurship and innovation in Brazil.

Two examples of how triple helix could work in Brazil

We present two examples of the implementation of the “triple helix” in a southern Brazilian state. Rio Grande do Sul is a state, an intermediate federal unit, in Brazil. It is the southernmost state, bordered to the west by Argentina and Uruguay and the east by the Atlantic Ocean. Its population is estimated at 11.2 million inhabitants in 2015 and 281,000 km², comparable in size to Italy. Rio Grande do Sul is one of the most industrialized states in Brazil with a highly

¹ ANPEI (National Association of Research and Development of Innovative Companies): Mapa do Sistema Brasileiro de Inovação. Available (2019): http://anpei.org.br/download/Mapa_SBI_Comite_ANPEI_2014_v2.pdf

diversified economic base and a high concentration of SMEs. Table 1 shows the characteristics of the two cases.

Table 1 - The characteristics of HT Micron and PCN cases

	Example projects	
	HT Micron	Cooperation Networks Program or PCN
Why? The context	<ul style="list-style-type: none"> The Brazilian government has decided to include semiconductor production as a strategy to improve the performance of companies in the electronics sector (Bortolaso et al. 2013) 	<ul style="list-style-type: none"> The economy of the State of Rio Grande do Sul is historically based on relationships between small and medium-sized enterprises. Faced with the crisis, these companies must find new forms of action to ensure their sustainability.
What? The objectives	<ul style="list-style-type: none"> Building a manufacturing plant of 10.000 m² for producing semi-conductors products (DRAMs, USB sticks, smart chips and memory, and SSD card modules): the largest production unit in Latin America. 	<ul style="list-style-type: none"> The government of this state has therefore decided to promote a stimulation program and networks of companies https://sedetur.rs.gov.br/redes-de-cooperacao.
Who? The actors	<ul style="list-style-type: none"> A consortium of electronics companies decides to partner with a South Korean company specializing in semiconductor production. A university agrees to collaborate with the joint venture created to locate the investment in its technology park. The Brazilian government and the government of the State of Rio Grande do Sul are providing financial support for the project. The city of Sao Leopoldo facilitates implementation and accepts local tax reductions. 	<ul style="list-style-type: none"> The government is creating a methodology for creating business networks. Community universities implement the methodology and thus disseminate public policy. The business networks created are amending the methodology to make public policy more effective.
When? The period	<ul style="list-style-type: none"> From 2009 to the present 	<ul style="list-style-type: none"> From 2004 to present
How? The results	<ul style="list-style-type: none"> Ecosystem in the field of semi-conductors industry from the blank page including a production company, an R&D center, a technology transfer center, a training program with Bachelor and Master degree (Coussi, Faccin, and Balestrin 2018). 	<ul style="list-style-type: none"> More than 280 Cooperation Networks were established in Rio Grande do Sul, involving about 8,000 companies and making the initiative a national reference in business cooperation. Surveys by the Micro and Small Business Support Department indicate an average increase in revenue from participating companies (26.51percent), an average increase in headcount (36.73percent), and an average increase in business investments (30, 95percent) and average cost reduction (13.38percent) (Verschoore and Balestrin 2011)

The higher education system in Brazil is composed of public, private and community universities, the latter being essentially philanthropic entities. Public universities are mainly funded by federal resources and are located in major urban centers across the country. Although administratively independent, federal universities are subordinate to the Ministry of Education and have little flexibility in defining local development policies. For a smaller number, private universities are part of a recent phenomenon of change in the Brazilian education system with the opening of for-profit institutions (Squissardi 2008). Community universities have historically developed on gaps not filled by public universities (Souza Lima 2011). In the State of Rio Grande do Sul, universities have a leading role in local development, often in a systemic, ecological and territorial approach.

A high technology ecosystem building from the blank page: the HT MICRON case

The case of HT Micron is representative of one of the greatest challenges facing developing countries, particularly in Latin America, which is the attraction of FDI. This case study focuses on the implementation and management of an investment project in Brazil by South Korean semiconductor manufacturer HANA MICRON, which is exemplary in size and regional impact. This FDI was localized by setting up a joint venture (HT MICRON) with a consortium of Brazilian companies in the electronics industry as an investment vehicle.

Brazil is one of the few countries among the world's major economies that does not have an electronic complex for the manufacture of integrated circuits (Gutierrez and Leal 2004). Also, although Brazil is one of the world's top five markets for personal computers, producing more than 70percent of what it consumes, it still depends on the import of semiconductors and displays to power its production lines. Semiconductors represent an increasing share of the cost of many products. Non-participation in the production of intellectual property or components of these microelectronic products will, therefore, have a very negative impact on the Brazilian industry and trade balance in the coming decades. Thus, there is no doubt about the importance for Brazil to obtain training in integrated circuit design and to participate in the microelectronics ecosystem (Bortolaso et al. 2013; Faccin, Balestrin, and Bortolaso 2016).

In this context, the sector attracts public sector support when it increases the country's ability to compete in the knowledge economy (Agência Brasileira de Desenvolvimento Industrial 2011). According to the report, the consolidation of a semiconductor components industry in Brazil is crucial for competitiveness, as it will create the conditions for increased innovation and wealth in technology. In this context, in 2009, the possibility of setting up the first semiconductor production plant in Brazil, located in the State of Rio Grande do Sul, emerged.

It is interesting to note that this project was a success after a non-linear and whirlwind process leading the project stakeholders to adopt (Coussi 2019). First, it concerns new behaviours: through personalized support and follow-up of foreign investors from the identification of needs to the adoption of the most relevant solution in terms of resources. Secondly, it creates new ways of operating: through collaborative work between the company manager, city technicians, the university project manager (in the name and on behalf of the university's governance) and government institutions. Third, it produces new knowledge: through the creation of a research laboratory within the university and a technology transfer center dedicated to semiconductor technologies and the research and development that will be conducted there. Finally and fourthly, this creates a social context conducive to the implementation of innovative solutions (e.g. investment in the production plant by the university and subsequent leasing to the company) for the anchoring of the FDI project in the territory and, above all, its appropriation by all stakeholders in the territory. This includes the creation of the conditions for matching university training with the skills required for good employability in the company.

It is then necessary to look at how the learning posture may have played out in the context of the HT MICRON project. Since 1994, a collaboration contract has been in place between UNISINOS University, the city of Sao Leopoldo and companies from all industrial sectors, but with a strong emphasis on innovation. This has resulted in the creation of an incubator within the university (UNITEC) which will become the technopark TECHNOSINOS in 1998. This new association was then recognized as very useful for managing the technopark grounds of

the university where the companies are setting up. This dynamic will continue until 2005 and companies are setting up and starting to operate.

On this date, the cluster's growth stopped at the same time as a political change at the head of the city government and a change of direction at the head of the university. Far from being negative, these changes are considered beneficial. Moreover, at that time, companies did not have as much interest in the growth of the territorial cluster because there was potentially a tension for recruitment. Indeed, the workforce available in the territory is not sufficient to satisfy the adequacy of supply to demand.

It was then that between 2005 and 2006, the city and the university became aware of SAP's project to set up in Brazil, marking their 9th international location. This episode is considered a key moment in the life of the technopark. The mayor of the city of Sao Leopoldo and the rector of UNISINOS are collaborating to obtain the location of the SAP company project on the territory of TECHNOSINOS. The supply of labor available for recruitment in the territory will increase because it is not only of local but also of national origin due to the increase in the reputation of the technopark. Three conditions made it possible to win the location and establishment of SAP in 2005. First, a memorandum of intent was signed between the university and the city mutually committing to work on the project. Secondly, the very good reputation of the technology park was decisive. Third, the technopark's ability to have a good compliance with SAP requirements: having two independent electricity and telecommunications networks to have a backup solution in case of problems. Fourthly, UNISINOS lent a building for the temporary installation of SAP and the town hall financed the upgrading of the various electricity and telecommunications network infrastructures.

It can then be seen that, with a few minor differences, the HT MICRON project has reproduced the same functioning, which demonstrates the learning effect that the HT MICRON project has had, despite a change of actors and stakeholders during the process, thus benefiting from a real transmission of experience. In the case of the establishment of the semiconductor manufacturing company HT MICRON on the UNISINOS University campus, we demonstrated in our research that through "Do It Yourself" and strategic improvisations, the network of actors involved has been part of a triple helix as practice strategy in the territory (Coussi, Faccin, and Balestrin 2018).

A low technology cooperation program for small and medium companies: the "Programa redes de Cooperação" (Cooperation Networks Program or CNP)

The development of inter-company cooperation is a major issue in government policies to support economic competitiveness. To optimize the dissemination and impact of these policies, public authorities can deploy specific mechanisms within which universities can have a central place. While the latter has full legitimacy to be active in innovation or technology transfer support schemes, it seems less natural to involve them in operations outside these fields, particularly in the case of non-technological companies. We present the lessons learned from a case study on a business cooperation program deployed in a state in southern Brazil through a partnership between the government and community universities in charge of its operational implementation.

The PCN case describes a public policy in southern Brazil that aims at the formation and diffusion of business networks in the state of Rio Grande do Sul. The study of the "Programa

de Cooperação" (Programme of Cooperation Networks or PCN) empirically illustrates the importance of promoting business cooperation for local development based on increasing the competitiveness of SMEs. Following its official promulgation, the PCN has become a public policy reference for the training and dissemination of cooperation networks between SMEs in Brazil. Because of the ability of this public policy to break with the individualistic practices of SMEs, it is interesting to understand how it works throughout its trajectory. Also, many recent studies present the main results obtained by the SMEs participating in the program, including the adoption of new working practices, cost reduction, the acquisition of new customers, the development of new suppliers, the increase in income and the launch of new products and services.

In the early 2000s, the government designed a series of measures to promote the economic development of the State, giving priority to the design of public policies to promote small and medium-sized enterprises. Among these measures is the PCN, a program aimed at *"strengthening micro, small and medium-sized enterprises in the most diverse segments of the economy, through the associative union between them"* according to Decree 42,950 of the State of 17 March 2004. Launched through a partnership with a community-university and seven consultants, the program is still active in 2019. As a public policy coordinator, the state government has signed partnerships with community universities to develop a methodology to support SMEs through collaborative actions and networking.

In the State of Rio Grande do Sul, community universities play a particular role in the development of higher education. These institutions develop to meet regional needs not addressed by state and federal entities and result from the combined efforts of social entities concerned with the social, economic and cultural development of communities. Thus, to implement this public policy, the State government has chosen community universities as operators since they are already involved in the various communities of the territory.

Concerning the operational dynamics of the program, three main actors are identified: the state government, community universities, and small and medium-sized enterprises. With regard to the responsibilities and roles of each actor, it should be noted that the State Government is responsible for transmitting the PCN working methodology (containing all the procedures to be followed by participants to implement it), for providing financial resources, for training consultants and for supervising all actions related to the formation of cooperation networks. The universities that signed the agreements with the government have created regional support centers throughout Rio Grande do Sul State that play a strategic role in raising awareness among entrepreneurs and building cooperation networks, seeking to adapt the program's methodology to the potential and specificities of each sub-region. In the agreements signed with universities, the criteria and actions to be prioritized are defined, as well as the guidelines, objectives and implementation phases established by the State Government coordination. The methodology developed by the government for the PCN suggests 12 months of work, divided into 23 phases, starting with basic action planning and finalization with the network's growth and development plan. In short, SMEs are expected to adopt the methodology and appropriate the program according to their requirements to strengthen their competitiveness.

The program was initially created with the clear objective of promoting a strategic option for SMEs through the formation of networks that maintain the independence and individuality of each member. The formation of these networks is based on four elements: horizontal

cooperation, associative nature, network expansion and independence from the public sphere. The small business networks established in southern Brazil are cooperation agreements between SMEs, legally independent companies that share a common objective and make the strategic decision to work together towards a competitive advantage. Nevertheless, these are competitive projects since all the members of each network come from the same segment sharing - in some cases - the same market. For this reason, they adopt as a mode of governance, coordination by their members, elected representatives to their assemblies.

Despite all efforts to invest in relationship-specific assets, establish knowledge-sharing routines, develop complementary resources and promote effective governance, the partnership has not been able to avoid what we call relational losses (unlike the relational rents proposed by Dyer and Singh (1998)). Inflexibility and distance from the public policy objective, rather than acting as levers for implementing public policies, are obstacles that divert the government from achieving its objectives.

By formalizing a partnership with several community universities, the State of Rio Grande do Sul has been able to support the creation of approximately 300 small business networks in its territory, demonstrating both the relevance of the public policy pursued and its operational and successful implementation. The government and universities have thus invested in legitimacy as a specific relational asset to facilitate communication with companies concerned by the program and targets of public policy. Besides, the knowledge sharing routines implemented by both parties have allowed for mutual knowledge on methodology and thus created cooperation networks spread over more than 100 consultants. Complementary resources, in themselves, the initial technical knowledge, the political power of government and local knowledge as well as the resources of universities have been able to create a strong synergy for the implementation of public policy. Finally, effective governance mechanisms under a contract have been established to govern the partnership.

Conclusion

In this chapter, we have presented two cases that illustrate the successful implementation of the triple helix model in an emerging economy such as Brazil. These two cases demonstrate in highly contextualized situations that the triple helix is a very good way to produce the dissemination of public policy to promote cooperation between SMEs, FDI and/or Firms. Also, these two cases illustrate the capacity of the triple helix at foster an innovative and/or entrepreneurial ecosystem.

More precisely, the first case shows that it does not necessarily require a prior concentration of companies and academic skills to build an ecosystem of innovation and knowledge production from the blank page. The second case shows that the university's role in economic development should not be limited solely to interactions with high-tech companies, but that its proximity to the local social environment is an asset for the creation of networks of small and medium-sized enterprises in the territories.

In the end, the concept of triple helix makes it possible to better understand the dimensions that influence the general business climate in a country such as Brazil. Other emerging countries could draw on these experiences to promote entrepreneurs in their countries.

Finally, it is interesting to look at the potential advantages and disadvantages of the triple helix model in the short and long term. Table 2 provides a summary of these and main associated challenges.

Table 2 - Potential advantages and disadvantage of the “triple helix” system in the short- and long-term

	Time horizon	
	Short-term	Long-term
Advantages	<ul style="list-style-type: none"> Information is constantly codified into new knowledge (recursivity and interaction). Knowledge and information flows become a new mechanism for coordinating society, in parallel and in interaction with existing (economic) trade relations and (political) control mechanisms. 	<ul style="list-style-type: none"> The promotion of public policies for innovation and entrepreneurship can be done through the triple helix model. The historical role of universities is preserved, and has been extended to better adapt to changing circumstances.
Disadvantages	<ul style="list-style-type: none"> Companies are often more technologically advanced than universities and have contributed to their development. 	<ul style="list-style-type: none"> The triple helix is unbalanced because the strategic function of expertise that the university could exercise to determine relevant investments in the knowledge economy, or to improve knowledge of the region's constraints and resources, is not recognized.
Key challenges	<ul style="list-style-type: none"> In countries such as Brazil, where governments are marked by histories of massive corruption, trust that the government or its representative bodies can be good partners is a major challenge. the application of this model to territorial dynamics requires a reconsideration of the weight of localized innovation trajectories in the analysis of the innovation process. 	<ul style="list-style-type: none"> Governments do not have the resources to support public policies: ending dependence on welfare policies can make collaborative practices that involve the government unfeasible.

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