WEAKNESSES AND STRENGTHS OF THE INNOVATION SYSTEMS IN A DEVELOPING COUNTRY. NEW STRATEGIES AND POLICIES FOR THEIR DYNAMIZATION: THE CASE OF PARAGUAY

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Weaknesses and strengths of the innovation systems in a developing country. new strategies and policies for their dynamization: the case of Paraguay

Keyword: innovation systems, developing country, weaknesses, strengths

I. INTRODUCTION

The economic dynamism of the countries in recent years have taken a qualitative and quantitative leap forward, achieving the growth of their economy, the strengthening of non-traditional sectors, as well as the achievement of greater welfare of the population. These results could not have been achieved without the accompaniment of a series of policy measures implemented by governments, through a commitment to the use of the endogenous structure of their territories.

The confluence of traditional and modern productive factors to government policies in areas related to industry, entrepreneurship, finance and education, to name a few, has involved a network of actions between different agents of society. This action reflects the action of a set of elements, which would not give incremental results working individually.

This reflection would mean that the agents of a territory are connected and interact to achieve their benefits, as well as for society. Therefore, according to the literature, it establishes the existence of a system, which allows economic units, government agents and other actors to interact, attracting innovative actions to their respective processes.

In this regard, this thesis will analyze in a systemic structural approach, the factors governing development and innovation in Paraguay. Therefore, the general objective is to Analyze the factors that condition development and innovation in Paraguay, with emphasis on the national innovation system, innovative capacity and articulation between the different elements of the system in order to develop proposals for its revitalization.

Consequently, the specific objectives will consist in; 1) Examine the structures that make up the NIS of Paraguay and identify the problems that strangle it; 2) Analyze the productive structure, specialization and business structure to describe strategies of the Paraguayan productive system and potential economic sectors; 3) Identify islands of innovation in Paraguay, its conformation process, current characteristics and evolutionary trends; 4) Analyze R&D policies in Paraguay; 5) Evaluate the challenges in terms of innovation policies, based on past experience and compared, making a comparative balance with other NISs in Latin America; 6) Suggest proposals for public policy measures to strengthen Paraguay's capacity for innovation.

According to the literature related to the case of Paraguay and statistical data from innovation surveys, they indicate that there are factors that strangle the innovation system in Paraguay, therefore, it is far from the technological frontier, and mechanisms that allow its sustainable development are not created. Therefore, the question arises; Is there an innovation system or is it a conceptual tool? In that sense, we analyze aspects that explain the weakness as a whole, what configures an unlikely activity? either through an analysis of the productive system, the public system, the education system, the intensity and organization in R&D, competition, cooperation and the financial sector.

II. LITERATURE REVIEW

Studies on innovation systems have gained remarkable relevance in recent years. Not, however, this topic had already been treated by List in 1841, as well

as the work of Schumpeter (1934). The literature regarding the subject was growing rapidly since the 90s.

From an evolutionary and systemic perspective, innovative capacity does not depend on a single actor but on a plurality of diverse elements (Innovative capacities of companies, public R&D systems, universities, training centers, human resources, public policies, etc.) and the type of relationships established between them. This articulation of the elements has been called the national innovation system [NIS] (Lundvall, 1992; Nelson, 1993; Patel & Pavitt, 1994; Mecalfe, 1995 and Edquist, 1997).

In accordance with the definition adopted by Chaminade, Lundvall, & Haneef (2018), referring to the work carried out by Lundvall, Vang, Joseph and Chaminade (2009, p. 7) establish the following:

> "A national innovation system consists of an open, evolutionary and complex system that encompasses relationships within and between organizations, institutions and socio-economic structures that determine the rate and direction of innovation and the creation of competencies that emanate from the processes of learning based on science and experience"

This system, in turn encompasses a set of subsystems, whose degree of interaction will be determined by the degree of congruence between them, the ability to generate synergies, leading to the development of learning, or, on the contrary, leading to failures systemic, where such processes are blocked.

For Vence (2007) based on Lunvall and Johnson (1992), this configuration is composed of elements such as; the business fabric, the public sector, the R&D system, the technological infrastructures, the financial system and the education system.

For Lundvall, the innovation system of a country or region is composed of the productive structure and learning processes, in other words, this concept is not limited to technological development or the R&D processes undertaken by

agents, but, It takes into account aspects other than those mentioned, or knowledge with a different scientific basis.

While innovation is considered as a cog for both developed and developing countries. In the case of Latin American countries there is a strong dependence on natural resources, both that determines their productive structure and their export dynamics. Although, this has provided a great opportunity in the opening of new markets, according to Katz (2016) they have not been sufficiently exploited to move forward seeking the catch-up with the global technological frontier and aspects related to the environment, equity and inclusion, aspects that had also been analyzed by the OECD (2010).

According to Johnson & López (2016) developing countries should rethink their NISs and see, which has worked before and is currently working well in other parts of the world and adapt it to their own specific situations. Dutrénit & Vera-Cruz (2016) argue that in order to accelerate the development process, sustainable and inclusive policies must be articulated, which strengthen and guide the NIS in a direction consistent with the social objectives.

A study conducted by the Konrad-Adenauer-Stiftung Foundation (2016) for 12 countries in Latin America, states that both the political and economic crises, the decrease in foreign exchange income due to stagnation of raw material prices, evidences the need to diversify the base of their productive development models. Innovation must be the key factor that allows diversifying production and reinforcing experiences in communities.

Cirera and Maloney (2017) indicate that aspects such as administrative and organizational practices improve the impact of R&D on innovation and productivity, therefore, public policy makers need to identify the barriers to accumulate these capacities, as well as, other complementary factors. This highlights the need for government to provide support for innovation activities carried out by companies.

The literature specific to the case of Paraguay is scarce. As starting references, citing the studies of Duarte-Masi (2010) on companies that benefited from national competitiveness programs between 2004 and 2007, in which, it was observed that companies had scarce economic resources in terms of innovation activities, being smaller or of little depth or technological value, indicating that the greatest investment was in the acquisition of capital goods. Later in 2013 and 2016, the first business innovation surveys were applied with support from the Inter-American Development Bank (IDB).

Research by Servían (2016) on the Paraguay national innovation system has identified a fragile, disjointed and divided system, due to the lack of a public policy to promote innovation, poor financing, lack of qualified human resources and the predominance of SMEs in the business structure.

III. METODOLOGY

The research methodology applied have a systemic-structural approach, combining qualitative and quantitative analysis.

The following research methods and techniques are envisaged; for the revision of the state of the art, it will be framed in a documentary-bibliographic design. Secondary sources are used as the database of the Paraguayan Business Innovation Surveys 2013, 2016 and the coming 2020. The detailed study based on microdata from this survey constitute the raw material for the empirical study. A correlation within variables will also be studied, such as employment, expenditure, investment, financing, cooperation, sales and a brief analysis of environmental variables.

As mentioned before, the secondary sources consulted include; the Permanent Household Survey and the National Economic Census (2011) of the General Directorate of Statistics, Surveys and Censuses of Paraguay (DGEEC), data from National Accounts, other economic and financial reports issued by the Central Bank of Paraguay (BCP), public finance reports of the Ministry of Finance of Paraguay (MH) and reports and other data on sectoral tables related to the

science and technology sector in Paraguay, the service sector and industrial policy of the Ministry of Industry and Trade of Paraguay (MIC) for a descriptive statistical analysis and other methodology for measuring variables to be defined in the development of the research according to the characteristics of the data available.

Other data and studies elaborated by international organizations, in addition to the elaboration of comparative tables with other countries that will be selected according to characteristics in which they are similar.

The research includes semi-structured interviews with Paraguayan companies in the following sectors: food, textile, automotive, printing, electricity, pharmaceuticals, information technology, medicine, metallurgy, household, telecommunications, consulting and financial. A total of 27 companies were visited, and the information obtained will be used for a qualitative analysis.

IV. PARTIAL RESULTS OBTAINED

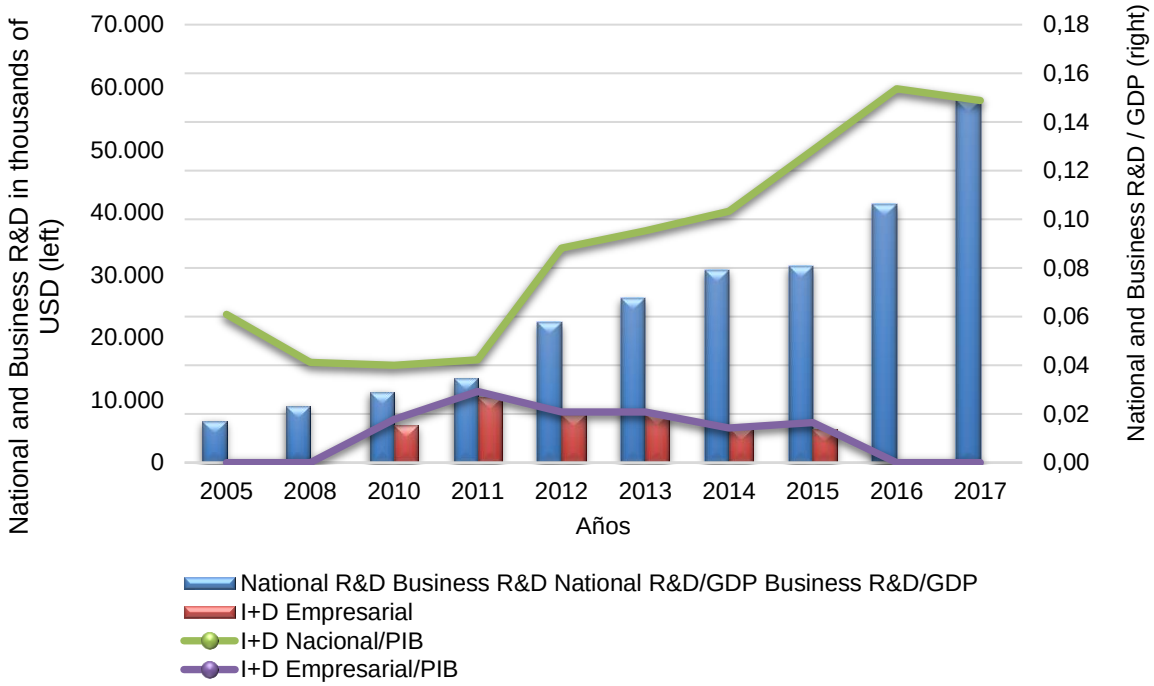
Partial analysis of components of the Paraguay NIS through the description of the role of the public sector, R&D policies and the business fabric.

a. Role of the Public Sector

The formulation of public policies related to the area of Science and Technology in Paraguay did not take place until the end of the 1990s, when the country was going from an authoritarian to a democratic government. Therefore, for a long period of time, the national debate on science was absent, which resulted in a lack of culture towards scientific research, weak appropriation of knowledge, and little or no innovation in goods and services, thus failing to formulate policy measures that focus on solving social problems (National Council of Science and Technology of Paraguay [Conacyt], 2008).

Investment in R&D in relation to gross domestic product in 2016 represented 0.15% (Unesco Institute for Statistics, 2016) (Figura 1). This is above Peru (0.12%) and below the average for Latin America (0.67%).

Figure 1. R&D expenditures in Paraguay. In thousands of USD. Period 2010-2015



Source: Own elaboration.

There are no aspects of an innovative state, as a buyer of technology as a user. Paraguay does not have tax incentives for R&D and innovation. However, aspects are identified in which the country is in the stage of creating bases with the aim of promoting R&D and innovation activities, such as greater investment in the digitalization of its processes and actions. Internet access is an aspect to consider, since 20.4% have access to it through various channels (General Directorate of Statistics, Surveys and Censuses [DGEEC], 2017).

The innovations implemented in the public service are related to improvements in organizational processes, such as the digitalization of the management of national government institutions.

The financing of the activities related to R+D+i, is given by different ways, either through public or private banks, in this case, there are credit lines for the implementation of technology. There are also loans and program funds from multilateral organizations and competitive funds from private companies.

Other sources such as crowdfunding do not apply in Paraguay. However, Guarantee Funds for micro, small and medium enterprises have been created in 2017.

At the beginning of 2019, with the aim of encouraging technology-based ventures, the foundations have been laid for the creation of an Angel Investment Network with funds from the Inter-American Development Bank.

On the other hand, as instruments of industrial policy there are laws in force that promote investment, among them, Law 60/90, the Maquila regime, with which investment is encouraged through the reduction of rates for the importation of capital goods (machinery), in addition to Law No. 5.542/15 (Investment Guarantee Law).

b. R & D policies

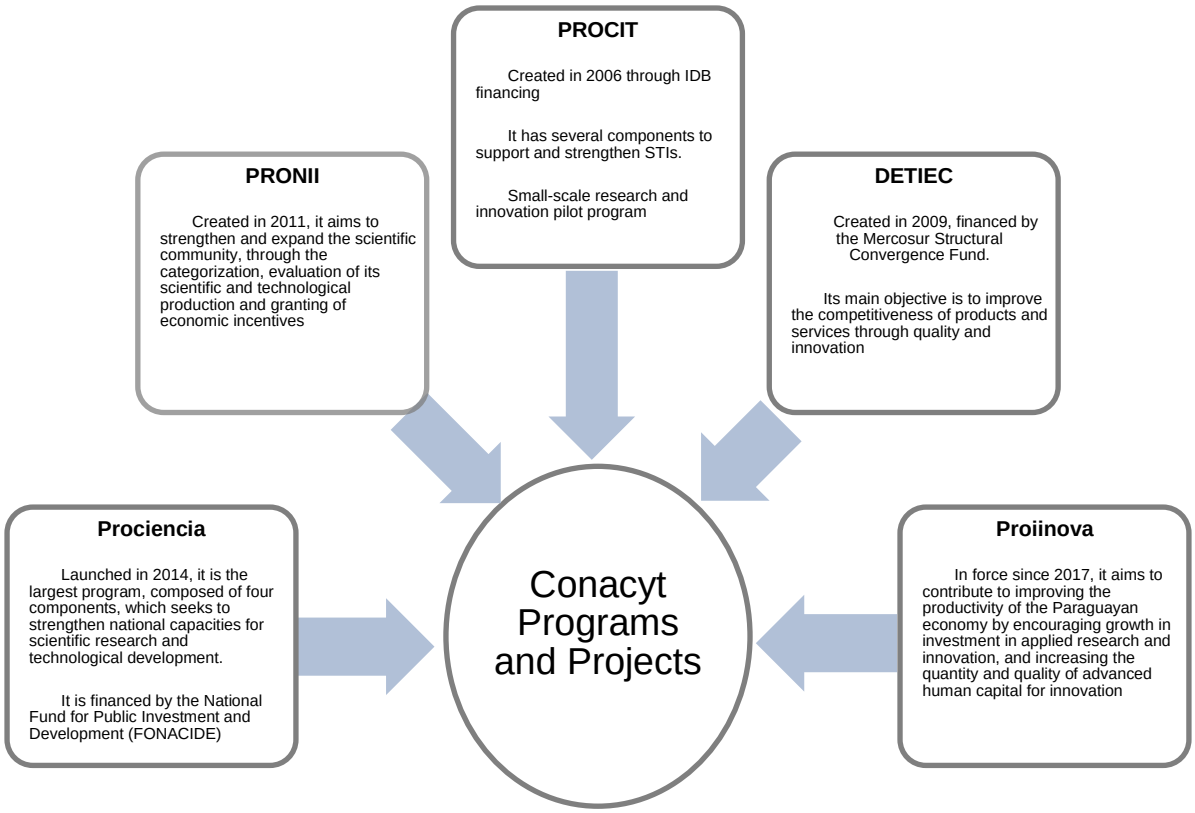
Among the main actors in the public sector is the National Council of Science and Technology (CONACYT). In 2017, the National Law on Science, Technology and Innovation was drafted for the period 2017-2030. As indicated in the document, this law seeks to develop strategies and actions to eliminate systemic coordination and articulation failures between actors and public policies (CONACYT, 2017).

This institution is the main financer of technology, innovation and quality initiatives, in 2017 it represented 31.9% of the total investment by the public sector.

The programs and projects include non-reimbursable funding for basic and applied research projects, economic incentives for national and repatriated

researchers, grants for graduate studies such as cooperation and research internships, funding for the creation of graduate courses, equipment for laboratories and technology centers, access to scientific and technological information, funds for the creation of offices and equipment for technology transfer and research results, funds for R & D projects to companies and technology centers, funds for incubation of technology-based companies, training of innovation managers to companies, among others.

Figure 2. Main Conacyt programmes and projects



Source: Own elaboration.

Although most of the programmes mentioned have not been in force for more than 10 years (Figura 2). In the last Business Innovation Survey (2016), 14.1% of the companies surveyed answered that they knew of a public innovation programme, in terms of the size of the companies, there was no major variation in the percentage mentioned. Among the best known public programmes was Procit with 91.4%. The Prociencia programme (42.6%) and the DETIEC programme (34.4%) were less well known.

c. Business Fabric

The Paraguayan business fabric is characterized by the predominance of micro and small enterprises (90.9%), which absorb 49.4% of the employed personnel. They are followed by medium-sized enterprises (5.9%), with 12.2% of the workforce, and finally by large enterprises (3.1%), which employ 38.4% of the workforce. The economic sector in which 55% of the economic units are located is commerce, followed by services with 34% and industry with 11% (DGEEC, 2011).

Investment in R&D by companies in 2015 was USD 5.2 million, which represented 0.2% of GDP (see Figure 1). While innovation expenditures were USD 123 million for the same year. The type of innovation carried out in the period 2013-2015 was 93% in products and processes, 5% in organization and the remaining 2% in commercialization.

According to the Business Innovation Survey (2015), 44.4% are innovative companies, and the remaining 55.6% are not.

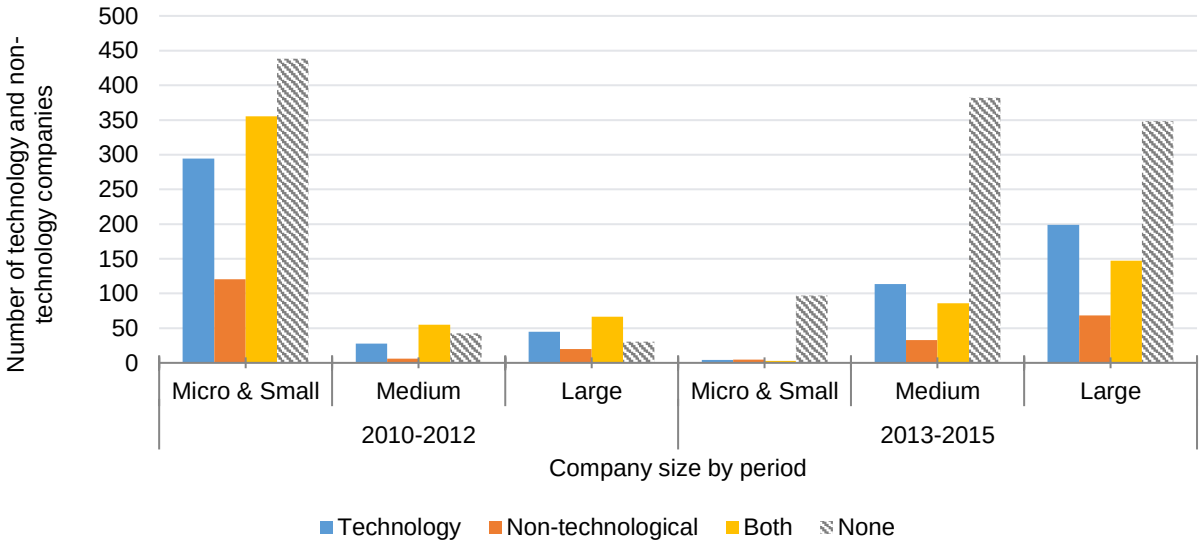
It was noted that internal innovation was the most accomplished, especially in the acquisition of machinery and equipment. In accordance with the economic activity of the companies, those that spent the most on R&D were those in the food sector (24.2%), the manufacture of pharmaceutical products (15.8%), the production of substances and chemical products (14%) and those dedicated to the manufacture of other types of transport.

An interesting aspect is that, of the companies surveyed, 62.7% do not innovate either in product or in process, 16.5% only innovate in process, 14% in product and in process and the remaining 6.8% only in product.

The innovative companies by type of innovation, according to size, indicate that both in activities such as product, process, organizational and marketing are the large companies that invest the most.

When it comes to innovation, both technological (21.3%) and non-technological (7.2%) types are carried out, those that carry out both represent 15.9%, while those that do not carry out any type of innovation represent 55.6% (Figure 3).

Figure 3. Number of innovative and non-innovative companies by size. Periods 2010-2012 and 2013-2015



Source: Data were obtained from the DGEEC/Conacyt/IDB Business Innovation Surveys 2013 and 2016.

The size of technological innovation companies is generally large (26.1%), medium sized is 18.5% and micro and small is 3.7%.

Innovative companies (99.5%) indicate that government support is virtually non-existent.

The main source of financing in the 2013-2015 period was through own resources (70%), while 30% obtained external financing either through public or private banks, government support, cooperatives or other sources.

As for the formal methods of intellectual property used in the period 2013-2015, 80.5% of innovative companies have a method of protection, which is the trademark (95.1%), patent (31.6%), industrial design (5.2%), utility model (2.1%) and others such as copyright, appellation of origin, confidentiality clause (38.8%).

When analyzing the cooperation between actors and institutions, 57.3% of the companies indicated that they had used some source of information, standing out in the areas of production and administration and finance. To a lesser extent in the areas of marketing, distribution and systems.

Among the external sources, 2.5% of the companies obtained information from other group companies or from the parent company. However, among the most noteworthy sources was the Internet (36.8%) as the most used tool, interaction with customers (26.5%) and suppliers (25.7%) was among the highest, followed by sources such as magazines and catalogues (21.9%). To a lesser extent were the links to competitors (9.5%) and hiring consultants (8%). However, the obtaining of information through Laboratories or through R&D companies, the consultation of patent and intellectual property databases, the relationship with Universities and public bodies and statistics reflected a lower use of these resources.

Among the main obstacles to innovation are those of an external nature, which were highly qualified in order of importance, such as: insufficient incentives for innovation due to deficiencies in public policies, scarcity in the labor market of personnel with the required qualifications of the company, difficulties in accessing or excessive cost of financing innovation, and scarcity or shortages in the company of personnel with the required qualifications.

While the obstacles mentioned as being of lesser importance were; Problems or deficiencies in the administrative or production organization, Deficiencies in the available physical infrastructure or too much difference between it and the required one and the Insecurity regarding the possibilities of appropriability of the results (protection via patents, secrecy, etc.).

V. POTENTIAL CONTRIBUTIONS

As mentioned, empirical literature is scarce in Paraguay. Several studies have been carried out with the aim of identifying the obstacles to innovation, but so far,

no in-depth systematic analysis has been carried out, particularly with regard to its relationship with the business fabric.

This study aims to be an analysis for future debates on public policy, as well as the debate on the administration of innovation from the government to companies.

The study on the National Innovation System of a country must be accompanied by a mixed analysis (quali-quantitative). This will serve the empirical literature to understand different perspectives of analysis in developing countries.

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