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### RESEARCH ARTICLE

## AN OVERVIEW OF CUBA'S BIOTECHNOLOGY INDUSTRY IN THE CONTEXT OF PRO-SOCIETY INNOVATION APPROACH.

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#### Abstract

In innovation theories, market-friendly approaches take attention as the dominant paradigm. Mainstream approaches consider the concepts of technology and innovation as the parameters on the basis of the market. The market-friendly paradigm accepts technology and innovation as a competitive tool in the market economy. However, it arouses curiosity whether a pro-society approach which doesn't focus on competition and profit, but instead, prioritizes the needs of the society and the convenience for the society to access the tools to meet such needs, would be possible and rational. An approach integrating the goals to make a contribution to the economic development of the country and to meet social needs, would be distinctive and important.

Cuba, which remains behind the developed countries in terms of both economic power and the level of R&D activities, has made a big progress in bio-technology and the pharmaceutical industry, indeed. The purpose of this research is to analyze the effect of society-oriented innovation on these developments.

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#### Introduction:-

It can be regarded in general that innovation is a process outstanding in the scope of organization and marketing (OECD, 2005). The paradigm mainly used in innovation theories and policies is noticeably market-friendly approaches. The performance increase axis of companies at the micro level and of the country which is at the macro level is an outstanding characteristic of these approaches. Mainstream approaches consider technology and innovation facts as primary parameters of the market and bring these dynamics into the forefront as competition tools in a market economy.

Differently, from mainstream approaches, the possibility of the existence of an understanding which is not basically motivated by competition and profit, and which is in favor of society and prioritizes easily access of society to the tools that will meet social needs, arouses interest.

In this context, the innovation story of Cuba, fallen behind in developed countries in terms of economic power and research development level, but, made significant progress in pharmaceutical industry, comes into existence as a worth- investigating a sample. This study aims to make an overall evaluation of Cuban biotechnology industries, which is an innovation sample compatible with economic development goals and social needs of the country

**Conceptual Framework For Innovation:-**

Innovation comprises the production of new goods, a new form of marketing and organization, and picking up of markets (V.Ruttan, 1971). According to the mainstream approaches; innovation process, referring to the transformation of an idea into a marketable product or service, a new or developed production or distribution process, new methods (European Commission, 1995), aims to increase the competitiveness of firms with the potential to contribute to economic growth and to improve market power (Sica, 2016).

Mainstream approaches consider technology and innovation as primary parameters of the market. Market-friendly paradigm regards technology and innovation as a means of competition in the market economy.

According to Schumpeter's innovation-based growth theory, focusing on the effects of innovation and entrepreneurship on economic development, considering capitalism as an evolutionist process; technological competition is the driving force of growth, and technological innovation and innovative firms are the source to the dynamism of the capitalist system (Fagerberg, 2003).

Schumpeter's basic motto is "creative destruction"; it is creative since creative destruction is based on innovation, and it is destructive since it excludes old technologies, and firms, unable to keep pace with new Technologies, from the market. Firms initially earn a monopoly profit by providing a cost and quality advantage compared to their competitors with the new technologies they have developed (Aghion, 2000). But, with the success of the new product and production process and rival firms' imitation this process, monopoly profit begins to decrease, which enforces firms to continuously develop new products and production processes.

**Pro-Society Innovation**

A pro-society innovation perspective does not consider the transformation of an idea into a product or service that can be commercialized, as the main factor. The only and main determinant of innovation is not being commercialized and competitive. Seeking to raise people's level of life is among the main motives of pro-society innovation

Innovation can be put into practice as one of the means, which actually raises people's level of life and meets social needs rather than increasing companies' profits. We see that this approach was tested in a "socialist" economy for a while. Cuba's approach to the fact of innovation can be said to be different from market understanding.

Despite the results of the US economic embargo over 50 years, Cuba has been able to establish a remarkable medical research capacity and biotechnology industry. In order to support the national health system, the country has successfully increased its health technology production capacity for many years and has raised its health indicators to a competitive level with developed countries. Cuba has principally considered people's health problems when a new product is developed, for example, the Genetic Engineering and Biotechnology Center was founded in 1986 for this reason ((WHO & EC & PAHO, 2015).

**General View Of Biotechnology Industry In The World**

According to the Convention on Biological Diversity, biotechnology is the technological applications in which the products and processes are created or changed by employing biological systems, living organisms or the derivatives of these for the purpose of a specific use (UN, 1992)

Biotechnology is mainly used in the pharmaceutical industry (biopharmaceutical drugs etc) and in agriculture. Two most important foot of global biotechnology industry are the US and Europe. By the year 2015, there are approximately 670 public companies with more than 200 thousand employees and 133 billion USD income in the biotechnology sector. By the year 2013, 170 billion dollars have been spent on global biopharmaceuticals (Statista, Biotechnology Industry).

US companies dominate the global biotechnology industry, and the United States earns 77% of global biotechnology income (2003) (Cárdenas, 2009)

**Table 1:-Biotechnology Industry in the World (2011-2017)**

|  |             |
|--|-------------|
| Revenues of European public biotech companies (2016)       | \$27 bn     |
| Number of biotech companies in the U.S.(2015)              | 2772        |
| Number of European biotechnology companies (2016)          | 2259        |
| <b>Selected Top Companies</b>                              |             |
| Revenue of Roche (Switzerland) (2017)                      | \$57,4bn    |
| R&D expenditure of Roche                                   | \$9,744m    |
| Revenue of Amgen (U.S.)(2017)                              | \$22,8bn    |
| Net income of Biogen Idec                                  | \$3,593.2m  |
| <b>Biopharmaceuticals</b>                                  |             |
| Total biopharmaceutical revenue worldwide (2011)           | \$157bn     |
| U.S. biopharmaceutical goods export volume                 | \$47bn      |
| Global biotechnology market size                           | \$369.62 bn |
| <b>Biotech in Agriculture</b>                              |             |
| Acreage of genetically modified crops worldwide (hectares) | 179.7m      |
| Acreage of genetically modified crops in the U.S.          | 70.9m       |
| Monsanto's net sales of corn seeds and traits              | \$5,953m    |
| Bayer CopScience's revenue                                 | €10,367m    |

Source: <https://www.statista.com/topics/1634/biotechnology-industry/>

The pharmaceutical industry includes many companies of different size and technological capacity in the world. There are 3 types of pharmaceutical product producers (Kaplan & Laing, 2005)

1. Integrated corporations: They are multinational companies that perform all stages of the production process. In addition, they create new molecular substances and distribute medical chemicals through their affiliated companies, licenses. They have gathered in a handful of developing countries.
2. Innovative firms. Research, develop and produce innovative treatments.
3. Reproductive firms; They lack the capacity to research. They purchase active pharmaceutical ingredients (APIs) from original innovators. Their medicines are sold under a trademark or generically under international or proprietary names. Some developing countries have an innovative pharmaceutical industry and can produce active ingredients. But, technologically simple stages of drug production are performed in most developing countries. Active ingredients imported from other countries are mostly used.

#### **Cuba's Innovation System:-**

It is observed that the system of science and technological innovation was founded in Cuba in the 1990s, and Cuba has an organizational structure that follows a science-technology policy, consistent with national economic development goals. This structure comprises Science, Technology, Ministry of Environment, research centers, universities, companies, and the integration and legal framework between them are among the main features of the innovation system (Balart, Hidalgo, 2015)

It was intended for science and technological innovation in Cuba to undertake a dynamic role in the country's sustainable ; in this context; the creation, transfer, adaptation, dissemination, and use of scientific and technological information were considered.

Cuba's science-technology innovation system is associated with the country's economic and social development strategies. The main role of the innovation system is to increase the role of science and technology in raising people's quality of life and economic development

Quality labor force, research, and production infrastructure have been provided by state investments, and a system based on information sharing, multi-discipline and multi-institutional working has been created in Cuba. One of the most important elements of the development of Cuba's biotechnology industry has been strategic control. The second important element is the long-term financial commitment provided by financial institutions to develop advanced technology. This ensured the allocation of resources needed to sustain the innovation process until it

creates profit. Organizational integration is another important feature of Cuba's biotechnology industry (Cárdenas, 2009).

### **Development and General View of Cuba's Biotechnology Industry**

Biotechnology has been an important element in Cuba's economy both due to the fact that Cuba speeded up the education of scientists and engineers since 1960s and as a result of the investments of the state, made from 1980s to 2000s (Evenson, 2007). Biotechnology seems the most innovative industry in Cuba.

The development of Cuba's biotechnology industry should be considered as being associated with the objectives of the country's economy, and as a part of the health system. The country had no domestic pharmaceutical industry until the revolution of 1959. The US embargo in 1962 forced Cuba to make new investments, and modernize existing facilities. Cuba has established MediCuba, an enterprise of the state, to provide equipment, technology, and medicine for the public health system; the import of finished medicines gradually decreased, and MediCuba concentrated on the importation of basic chemicals for manufacturing in Cuba. Cuba's first exportation was for conventional drugs in the WHO's main drug list. It is remarkable that the country made an investment of one billion dollars to Western Havana Biocluster including 52 institutions between 1990 and 1996 which is a critical period for the development of biotechnology in the country. The state spent 1.2% of GDP for the biotechnological development in the country, where the core of the biotechnology industry has been formed by small groups (Cárdenas, 2009).

Cuba's first exportation in the biotechnology sector was made for medicines in the "conventional" list of the World Health Organization (WHO). By the year 1987, Cuba imported chemicals of 34.6 million dollars and exported pharmaceutical products of 70 million dollars to Western and Latin America. Cuba's pharmaceutical production capacity is supported by production (Govindaraj, 2001 as cited in Kaplan & Laing, 2005). Cuba produced 1150 biological and diagnostic products, 3 drugs without a prescription, and 132 generic drugs in 1993, and earned 100 million dollars export income per year, with the growth of the local pharmaceutical industry in the mid-1990s (Grogg, 2001, as cited in Kaplan & Laing, 2005). Cuba, which has developed products not only for the domestic market but also for the international market, is the only country in the world, which developed the first effective vaccine against meningitis (meningitis B). It provided this vaccine to all children in the country as free of charge and sold it to the countries such as Argentina, Colombia with cheap and fixed prices. China, Cuba provides 40% of the raw material used by the pharmaceutical industry, and today at least 80% of the pharmaceutical products used in Cuba are domestic production (Tancer, 1995 as cited in Kaplan & Laing, 2005)

According to the Ernst & Young report (as cited in Evenson, 2007); Cuba's biotechnological product export amounted to 300 million dollars in 2005. The hepatitis B vaccine for which the certification of pre-qualification for utilization was obtained from WHO in 2001, is one of the most successful innovative products of Cuba's biotechnology. Based on this success, Glaxo-Smith-Kline, a British company, signed a license agreement in 1999 with Cuba's Finlay Institute, to produce meningococcus vaccine using Cuban technology and distribute it to Europe and North America. In addition, Cuba continued the clinical trials of Cuban therapeutic cancer vaccine. Cuban biotechnology, having grown with its registered products in more than 55 countries, obtained 100 patents by the year of 2004, and has received over 500 patent applications around the World (Evenson, 2007).

Cuba was able to develop advanced technology despite making R&D expenditures (0.6% -0.8% of GDP) far less than developed countries (the USA, 2.7% of GDP, Finland, 3.5% GDP etc.) (Cárdenas, 2009).

The Cuban government established the National Center for Scientific Research in 1965. During this period, education was also promoted as a free right and an element of development. However, it did not become an important part of the Cuban economy until the Center for Genetic Engineering and Biotechnology was established in 1986. Biotechnology organizations today are involved in Scientific Pole, and mainly has 10 centers, and about 50 research and production institutions employed 1500 researchers working in these centers (Evenson, 2007):

1. Center for Genetic Engineering & Biotechnology (CIGB)
2. The Finlay Institute
3. Center for Molecular Immunology (CIM)
4. The National Center for Bioproducts (CNB)
5. Pedro Kourí Tropical Medicine Institute (IPK)

6. National Center for Neuroscience
7. National Center for Scientific Research (CNIC)
8. National Center for the Production of Laboratory Animals (CENPALAB)
9. National Center for Agricultural & Animal Health (CENSA)
10. Center for Immunoassays (CIE)

The Cuban biotechnology and innovation system has been designed as a part of the state-financed health care system. Therefore, its first aim is to meet the public health needs, export is its second aim.

An innovative connection has been established between research organizations, biotechnology organizations, regulatory agencies, and the health care system. The patents in Cuba belong to the state, there is a patent pool, and innovation is an open source, which makes transaction costs almost zero and speeds up research & product development. West Havana Biocluster, which provides a strategic network between companies and is under the control of the State Council, is one of the most important elements of the organizational integration. The structure gathering company representatives, government representatives and related organization representatives to make decisions in line with public needs and export requirements constitute the Strategic Decision Body of Cuban biotechnology industry. Each sale or participation agreement is approved by this unit (Cárdenas, 2009). Science-technology activities are mainly financed by the Cuban state.

### Conclusion:-

The main focus of the market-friendly approaches, which are the dominant paradigms in innovation theories and policies, is to enhance the competitive performance of the companies at micro-level and the country at macro-level. Mainstream approaches considering the concepts of technology and innovation as the parameters on the ground of the market, prioritize these dynamics as a competitive tool in market economy.

Cuba, which is an alternative to the market-friendly paradigms that regard technological development and innovation as a tool of acquiring competitive power and increasing profit of companies, has regarded innovation as a part of economic goals of the country and of the public needs.

Being in a search of increasing living standard of public and ensuring easy access to new treatments, despite little amounts it has allocated for research & development activities has canalized Cuba to make incremental innovations in biotechnology and pharmaceutical industries.

This search and sectoral achievements of Cuba has formed a worth investigating model for pro-society alternative approaches that regard social needs and social benefits as primary motivation tools.

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