# *NOTES ON THE CONCEPTION OF TECHNOLOGY DEVELOPMENT FOR ARGENTINA AND LATIN AMERICA*

## Introduction

The last years have been very important for science, technology and innovation (STI) policies in Argentina as, for the first time in our history, we have been in the presence of a policy transcending all actions and instruments ever executed in this field.

The creation of the Ministry of Science, Technology and Productive Innovation (MINCyT), as a continuation of the former Secretariat, is one of the rare national cases of continuity in the diagnosis and consolidation of measures between governments openly opposed in their economic and social policy orientation.

An increase in the public budget for the area, the creation of a dense and professionalized ministerial structure according to the diagnosis of the national situation, and the reformulation of strategic plans with high social participation are some of the most important facts deserving a mention. With all this, Argentina seems to be at a foundational moment in history.

However, the situation does not look simple. There are many achievements but also major challenges.

In spite of the continuity and consolidation of STI measures, instruments and policies, the purpose of contributing to the achievement of a qualitative change in national production has not been accomplished.

The national production pattern seems to have changed neither at sectorial nor at intrasectorial level.[1] Similarly, science and technology (S&T) indicators do not seem to have delivered the expected result: the R&D percentage of GDP, the composition of R&D, the almost exclusively public origin of researchers, and the amount and quality of the relation among institutions of the national system of STI (NSSTI), among other measures, evidence so.

The question is then to develop knowledge in order to understand the limits to STI development in countries like Argentina and other main countries in Latin America.

***The hypothesis of this paper is that mainstream conceptual frameworks, on which knowledge is intended to be built to contribute to the design of STI policies, are not appropriate to understand the development processes of dependent countries, which entails policy assessment and diagnosis errors.***

This paper is structured around five sections. The **first section** begins describing the emergence of what is considered as a new "technological paradigm." It will be intended to prove the relation between technology business opportunities in the context of this new technological paradigm with the appearance of a new body of knowledge about the

[1] As recognized by the MINCyT, the national production pattern "… is based, on the one hand, except for some recently dynamic activities (such as those related to biotechnology and software), on natural comparative advantages, with the agri-food industry and, more recently, large-scale mining standing out, and, on the other hand, on a relatively small group of capacities accumulated upstream in the manufacturing sector, particularly in process-intensive scale industries and commodity producing industries (such as the steel and aluminum industries, and, to a lesser extent, the paper and petrochemical industries)" (PNCTI 2012-15, p. 23).

origin, nature and perspective of economic development phenomena on the basis of technology development. Also, the main characteristics of approaches consolidated as dominant (or mainstream) in this field of knowledge will be shown.

The **second section** will show that, while there have been many development cases in the 20th century, mainly based on the experience of new industrialized countries (NICs) from Southeast Asia, the "model" considered an example of development is that of the United States, particularly because the "institutional reform" measures which in the early 80's made it more efficient than others to compete in the new technological paradigms seem to have been taken in it.

Specifically, the section highlights the measures for the extension of intellectual property (IP) rights, promotion of the public-private articulation, and creation of small technology companies. Unlike other development experiences, the American model would show that, in order for a development process based on new technologies to begin, it would only be needed that the State create the necessary incentives to encourage economic and institutional units to invest in and develop technologies for the market.

The **third section** will describe the policy recommendations derived from this mainstream approach, focusing on the importance of the State creating a "system of incentives" which promotes the virtuous behavior of the components of the innovation system.

This would confirm and reinforce the culturally dominant idea that enterprising entrepreneurs, in a context which promotes their growth and development, are the driving force of technology development. Therefore, it would be the American institutional scheme the one recommended as a "model" for countries seeking development. Special emphasis would be placed on its impact on Latin America.

Despite the fact that this experience would seem to be decisive, the **fourth section** of this paper will seek to make a historiographical review of the American case and, on that basis, refer to the validity of the assumptions of mainstream approaches.

Such a review will be intended to show the historical reason for the measures which had an impact on the American "institutional system." The **fifth section** will describe how those measures presented as tending to foster the entrepreneurial spirit in a context of free competition actually intended to create barriers tending to benefit the own American industries and created legal measures to make it difficult for potentially competing countries to have access to technologies which used to be freely available.

On the other hand, it will seek to show that the reconversion process of the American industry did not result from the modification of its institutional arrangements, as regards intellectual property management, the public-private relation and the creation of small technology companies, but from the role acquired by its large companies or its projects associated with the Big Science (generally in connection with the war industry).

Finally, the **sixth section** will present the conclusions. It will seek to make a comparison between the conception of mainstream approaches and the findings from the historiographical review. In particular, it will seek to show the differences between the role of the State and policies in the process of development. This section will also seek to show the need to work on a critical theory which surpasses mainstream approaches.

## 1. Emergence of a New Technological Paradigm and the appearance of the Mainstream Conceptual Framework

In the last decades, some specialists have held that a "new technological paradigm" (Pérez, 2004) based on three technologies widely used but with different productive impact has consolidated:

- Information and communication technologies (ICTs),
- Biotechnology,
- Nanotechnology (particularly, new materials technology).

These three technologies are different but share some relevant characteristics. First, they have a massive and comprehensive potential application. Almost everything we can see and touch in everyday life could be modified by the application of these technologies.

Second, these technologies may be considered relatively less "capital-intensive" and more "brain-intensive" than other major technologies of previous technological paradigms: the chemical, electrical, pharmaceutical, steel, nuclear energy, aerospace, automotive and other industries.

This relatively less need for product development capital is the reason why certain countries with good natural resource endowment and excellent scientific capacities, like Argentina, try to base their technology development on them. In fact, it seems possible for public institutions and small companies to obtain new products based on these technologies[2].

Third, it began to be understood that the new brain-intensive companies have not only specific technical requirements but also a particular financial structure according to the product development stage (angel capital, seed capital, venture capital, and finally, IPO). Also, the technologies of new paradigms have their own particular intellectual property, institutional and other requirements.

For the above reasons, the experience from requirements in biotechnology and ICT developments gave rise to a new academic field: the policy, management and business studies in STI processes.

Perhaps because one of the main academic antecedents in the study of the relation between technological change and economic development derives from the work of Joseph Alois Schumpeter is that many of the most important authors in the study of STI development processes are called "neo-Schumpeterians."

Neo-Schumpeterians and their eclectic fusion with other theoretical approaches in their treatment of STI (evolutionists, authors of the "path dependence theory," institutionalists, etc.) constitute the mainstream academic school in the study of these topics.

However, the role of the analytical approach of "national systems of innovation" (NSIs) deserves a mention, due to its synthesis and syncretism capacity in relation to the conceptual frameworks and because they have been an inspiration for the design of many STI policies in Latin America (and other less developed countries) since the 90's.

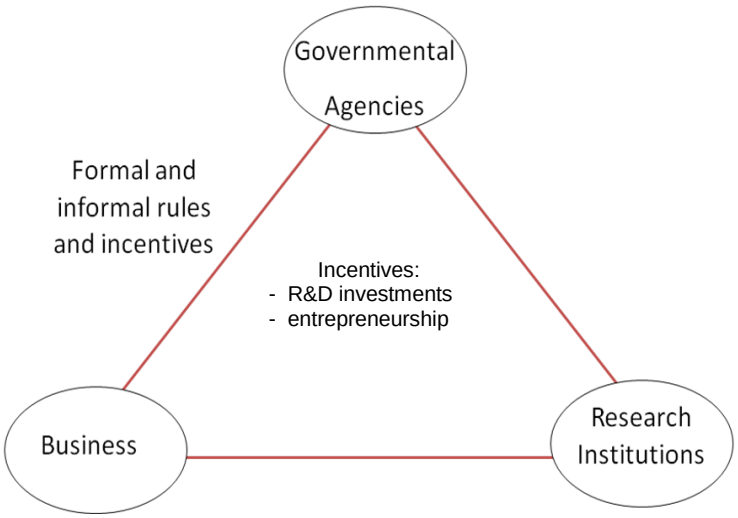
[2] Examples are Genentech in biotechnology and Microsoft or Apple in ICTs. They are cases of entrepreneurs that, thanks to their creative will and capacity to attract risky investments, managed to establish multinationals. Therefore, it seems that there is no economic limit for development.

Even when these approaches which constitute the mainstream school are very different from each other, they share the emphasis on the importance of the "institutional system" for economic and technological development.[3]

From a broad perspective, the institutional system is a set of rules - both formal (constitutions, laws, property rights, etc.) and informal (taboos, customs, traditions, etc.) - which give a sense to and guide the behavior of individuals and groups in a society. In particular, the innovation-related institutional system involves different "subsystems," such as the financial system, the educational system, the system of intellectual property right protection, etc., i.e. a set of systems which provide predictability and encourage or discourage certain behaviors.

The systemic operation of institutions shapes the interaction among the most important stakeholders in technology innovation: governmental agencies, private companies and universities.

Schematically, it could be represented as follows:




On the basis of these ideas, it could be understood that there could be good and bad national systems of innovation, the good being those in which the State would be capable of creating appropriate incentives for private investment in technology development and for the efficient management of such technology development in public agencies, companies and between them.

This would be the difference among countries: the capacity of States to create a consistent institutional system of incentives which rewards the development of technology businesses.

---

[3] The emphasis on the institutional system as a determining factor of economic and technological development can be appreciated in the following quotes of the main authors of mainstream approaches in the study of STI:

- Ronald Coase, Oliver Williamson and Douglas North founded the International Society for the "New **Institutional** Economics";
- Christopher Freeman talks about "the network of **institutions**";
- Lundvall mentions that: "The **institutional** set up… is the second important dimension of the system of innovation";
- Carlsson and Stankiewicz point to the "particular **institutional** infrastructure… involved in the generation, diffusion, and utilization of technology";
- Nelson and Rosenberg stress "the **institutions** and mechanisms supporting technical innovation."

The empirical information provided by these mainstream approaches would show how more technologically developed countries became so after the creation of an institutional system appropriate for the development of businesses and technology entrepreneurship.

## 2. The American "Model": The "Exemplary" Legislation

The emphasis on the institutional system as a cause or obstacle to the technology development referred to by the analytical framework of NSI is based on the experience of some developed countries (DCs).

While Freeman (1987) based on the Japanese experience to identify and characterize a successful NSI, the modification of the American institutional system in the 80's is considered as the policy reference. The American case is taken as an example by both the other DCs and countries seeking development. It would show how the improvement of the system of incentives, resulting from an appropriate institutional system, could increase competitiveness through technology development.

Usual literature on this American process by authors dealing with NSIs is largely based on the view which the authorities and representatives of DCs have about themselves. According to this view, the successful growth of the United States since the 80's would be due to the country's own capacity to understand transformations in the world technological and productive contexts and the consequent national capacity to set competitiveness goals and the reconfiguration of the institutional system to reach them.

In order to develop tools for the achievement of these objectives, a political reform would be needed to be pursued in which the key to institutional changes lied on the transformation of laws relating to intellectual property and technology transfer. In other words, unlike the experience of NICs from Southeast Asia, the American case would show that there would be no need for strong States accomplishing major structural transformations for the economy but simple legislative changes aimed at guiding microeconomic decision-making with efficiency.

Indeed, on the one hand, due to the risk and size of R&D investments, the legal mechanisms through which private investors could recover their investments in case of a successful result would need to be improved. To this end, companies competing for technology would need to be protected against the unfair copying or appropriation of their research results. With the extension of these rights, inventors could gain not only moral recognition as authors but also economic recognition, which, from this perspective, would be a double incentive for their work.

On the other hand, American legislators would have understood, and the American society would have appreciated, that innovation is a "systemic process." An institutional organization prepared for a few to research and make their results available to the entire society and for others, represented by the productive forces, to take that part of the results useful to obtain innovative products would no longer be effective.

Schematically, these laws on intellectual property and technology transfer could be divided into two groups. On the one hand, there are the U.S. Patent and Copyright Acts, whose updates would have allowed for greater protection of research results as the conceptual scope and time range of what is "protectable" was widened. This would have encouraged private investments in R&D, would have served as an incentive for

researchers to reach the market with their technologies and would have favored the creation of small technology-based companies (TBCs).

On the other hand, there are the so-called "Laws of Innovation," meaning those which transformed the relation between public institutions and private companies on the basis of the possibility of registering, licensing and exploiting the results of research funded with federal funds.

The American Laws of Innovation include a dense set of measures.[4] However, the **Bayh-Dole University and Small Business Patent Procedure Act** of 1980 should be mentioned because of its importance as the inspiration for a large part of the institutional reform in S&T systems of both DCs and countries seeking development.

This Act allowed universities, research institutes and State's contractors to protect under their own name, exploit or license to small businesses, under the conditions they consider appropriate, the results of their research financed with federal funds.

Its primary objectives would be:

1) To favor research with productive impact through technology transfer,[5] and

2) To promote the creation of small and medium-sized technology companies.

In fact, the Bayh-Dole Act, together with other Small Business promotion measures, such as the favorable system of incentives to entrepreneurship and the system of funding appropriate to the different stages of the needs of technology developments (angel capital, seed capital, venture capital funds, IPO), are considered the determining factors of the continuous technological dynamism and the largest proportion of job creation. The results of the Bayh-Dole Act are certainly significant in terms of university patenting, technology transfer, the establishment of businesses and employment.[6]

---

[4] Such as the Stevenson-Wydler Technology Innovation Act of 1980 and the Federal Technology Transfer Act of 1986. Also, although they are not laws, mention should be made of the creation of the Federal Laboratory Consortium for Technology Transfer and the cooperative research and development agreements (CRADA).

[5] As mentioned by Henderson and Smith (2003), its main specific objectives include:

- "to promote the utilization of inventions arising from federally-supported research or development;
- to protect the public against nonuse or unreasonable use of invention;
- to promote collaboration between commercial concerns and nonprofit organizations, including universities."

[6] According to the Association of University Technology Managers (**AUTM**), the Bayh-Dole Act 2012 had the following impact:

- 591 new commercial products were introduced;
- 4,899 licenses were executed;
- 1,152 options were executed;
- 416 executed licenses contained equity;
- 38,600 was the total number of active licenses and options;
- 670 new companies were formed;
- 3,927 startup companies were still operating as of the end of financial year 2011;
- 58 institutions reported that 2,821 of their licenses paid $662 million in running royalties based on $37 billion in product sales;
- Total income for all U.S. institutions from running royalties was $1.5 billion.

On the impact of the Bayh-Dole Act, Lita Nelsen (1998) concludes that: "These results of university licensing have been noted with great interest by local communities, state legislatures, the U.S. Congress, and many policy-makers abroad. Locally, some universities have noted a lessening (and even "sweetening") of the "town/gown" conflict, as cities such as Cambridge see new companies and jobs

As a consequence of these results, in concurrence with the diagnosis made by the United States in the 70's on the insufficiency of its own system of incentives to private investment in R&D and the low efficiency of public research in delivering productive solutions, most reforms of the Latin American institutional system of S&T were inspired by the Bayh-Dole Act.

## 3. Policy Recommendations and Changes in the Institutionality of Latin America

The influence which mainstream conceptual frameworks on STI have had on S&T policies in Latin America is significant. The idea of the national system of innovation as a conceptual framework was adopted rapidly, and regional and national issues in Latin America were addressed through it.

It was found out that, even though various formal elements of the national systems of innovation of capitalist developed countries (national bourgeoisie, universities, established scientific and technological institutions, etc.) already existed, local knowledge building did not result in the development of projects with national technology allowing to transform the productive profile of the region into a more "knowledge-intensive" one.

To explain this, the mainstream conceptual frameworks tried to understand what other theories did not explain: which the historical path taken by Latin American nations was and what institutional and incentive system would have resulted from such a path so that the formal components of the system failed to behave virtuously in pursuit of innovative development.

Most authors of the mainstream conceptual frameworks agree on the diagnosis of the characteristics of the components of NSIs in Latin America. In their view, the problem of less developed nations lies on the institutional and cultural determinants of the historical scientific, technological, productive and political behavior.[7]

This institutional and cultural interpretation was and is the view also developed by multilateral credit agencies on the nature of Latin American problems.

---

springing up out of the universities in their communities. **State governments are setting aside moneys specifically to fund technology transfer offices and new-company incubators in their universities. The phrase "Bayh-Dole" is heard frequently in Japan and Germany as their educational ministries seek to emulate the U.S. university technology transfer system.**"

[7] Mention should be made of the following interpretation of the central "components" of NSIs:

i) Most Latin American industrial companies, as a result of the State protection during ISI, would not develop technological or entrepreneurial activities but rather adopt a rent-seeking and speculative behavior associated, directly or for its negative consequences, with the past collusion with the State;

ii) The State would have implemented demagogic and populist policies and wasted historic opportunities which, together with budgetary restrictions resulted from political instability, would discredit the State and would cause it to act in a reckless and inefficient way in relation to long-term planning;

iii) Science and technology institutions, instead of being the actor capable of overcoming this lag, would have withdrawn, partly because they would have been co-opted by ideologies opposing to the market and partly because they would have acted following "universal-scientificist" criteria (in opposition to national-technological criteria), which would have turned them into a context detached from reality and the productive needs of the less developed countries in which they acted.

In effect, as João Márcio Mendes Pereira (2006) mentioned in reference to the view of these multilateral organizations: "The "discovery" of the importance of "institutions" (Naim, 2000) for development brought, for the first plan of the formulation of the neo-liberal agenda, the "new institutional economics." This branch of knowledge seeks to develop a theory on the formation and evolution of institutions which can be incorporated into neoclassical economics and be compatible with it (Medeiros, 2001:78)."[8]

As regards policies intended to generate a behavioral change in national science and technology institutions (NS&TI) and companies, mention should be made of the promulgation of Latin American Laws of Innovation, similar to the Bayh-Dole Act, which was their inspiration, and the creation, or recreation if already existing, of funding sources or agencies.

Special reference will be made to these funding sources or agencies not so much for their impact as for being a perfect example of the interpretation and expected way of resolution of Latin American technology problems from the NSI perspective.

It could be said that their overall objective was to generate new incentive mechanisms encouraging NS&TIs to coordinate activities among them to avoid inefficiencies and relate more closely to private companies, in order to contribute to the creation of a true national system of innovation.

Funding sources and agencies would lead to perform tasks which are not considered a priority by NS&TIs' own internal selection mechanisms or are not promoted by them in the manner and time considered essential by the national authorities.

In following impact measurement, assessment, monitoring, relevance and/or quality criteria different from those of NS&TIs, funding sources and agencies would have asserted their distinct selection approach and helped to develop activities with the strength and speed which the country needed and without increasing the bureaucracy of NS&TIs.

Particularly, funding sources and agencies promoting scientific and technological activities had clearly established criteria for awarding public-private relations. To establish this relation, they sought to coordinate and promote the cooperation of NSI institutions prioritizing the joint development of collaborative projects between the working groups of NS&TIs and between these and companies.

## 4. The Critical Review of the Model and the Mainstream Conceptual Framework: the American Innovation Legislation in Context

As explained so far, the mainstream conceptual frameworks stand out for their consideration of technology development as central to the development of society as a whole and relate such technology development to an institutional system which establishes a system of incentives favoring or opposing technology innovation. This approach was summarized by the analytical framework of the national system of innovation.

[8] In particular, since the late 80's and mainly during the subsequent decade, the World Bank (WB) and the Inter-American Development Bank (IADB) have made their credit lines conditional on the adoption of measures to overcome the technological problems affecting "institutional quality." The conditions of the IADB were particularly drastic to transform what they believed was the main obstacle to Latin American innovation: the inaction of science and technology institutions for institutional culture reasons.

Also, as mentioned above, the experience of the U.S. legislation is the world model of State involvement in the establishment of an institutional system conducive to innovation. For this reason, the American legislation, interpreted within the analytical framework of the NSI, inspired S&T policies in less technologically developed countries.

The early seizure of technology production opportunities, generated by laws promoting national institutional changes, would be what eventually would allow them to create real national/regional/local systems of innovation.

Let's see then if this is what really happened in the institutional system considered as international reference by the mainstream conceptual frameworks on STI.

As already mentioned, U.S. laws on IP protection were amended in the early 80's. The American economy would also undergo a significant change, meaning, to the entire world, the abandonment of the postwar economic "paradigm" as an expression of the end of the "golden age" of capitalism. Such a turn became evident in the transformation of a society so far based on the so-called "welfare state," or "Keynesian economics," which began with Roosevelt's New Deal, into "neo-liberal" economics (personified by Reagan, and Thatcher in the United Kingdom).

In the mid-60's, the speed of the American growth, which so far had benefited financially and commercially from the War and the reconstruction process, began to slow down. As a consequence, the U.S. dollar, supported by the American economic and political hegemony in the Western world, began to be questioned as a reserve currency and in the 70's ceased to exist as "dollar standard." At the same time, the U.S. economy started to feel the impact of the industrial competition generated by companies from countries "reconstructed" by United States itself, such as France, Germany, Japan and the NICs.[9] In addition, a major external shock risked the "American way of life" as production and consumption pattern, since the first oil crisis took place in 1973.

For these reasons, in the early 80's, as the U.S. Government perceived that it was losing its leadership (mainly at the expense of the evident development of Japan),[10] it responded to world economic and technological changes by planning its re-adaptation to compete in new technologies with advantage.

The most affected sectors were the American industry based on high-tech industrial goods (electronics, computers, microprocessors, pharmaceuticals, etc.), the production of differentiated industrial goods based on new automated production processes (the automotive, shipbuilding and aeronautics industries), and heavy industries (the chemical and steel industries). This circumstance evidenced the need to restructure the American industrial organization in order to compete.

---

[9] On the fall of the American competitiveness, Correa (1988, p. 16) states that: "The figures of the U.S. Department of Commerce show a fall in the trade balance of high-technology goods from 26.7 billion U.S. dollars in 1980 to - 2.6 billion U.S. dollars in 1986. The increase in imports from Japan and the NICs is responsible for a significant part of such a deficit... since the late 70's those countries have achieved a trade surplus with the United States comparable to that of the EEC."

[10] Freeman (1995) states that: "Japanese industrial R&D expenditures as a proportion of civil industrial net output surpassed those of the United States in the 1970s and total civil R&D as a fraction of GNP surpassed USA in the 1980s. The Japanese performance could now be explained more in terms of R&D intensity, especially as Japanese R&D was highly concentrated in the fastest growing civil industries, such as electronics. Patent statistics showed that the leading Japanese electronic firms outstripped American and European firms in these industries, not just in domestic patenting but in patents taken out in the United States (Patel and Pavitt, 1991, 1992; Freeman, 1987)."

For the U.S. Government, as a defender of its national capital, such a situation justified the destruction of the biggest advance made by the 20th century civilization, the welfare state, and its policies took a neoliberal turn: the reduction of the State and market growth.

The adopted strategy consisted in favoring the largest industries with the greatest competitive capacities so that they reorganized to develop new technologies. Indeed, the policies implemented were those which increase the efficiency of already competitive industries while destroying, as an "unnecessary burden," the weakest and least competitive ones (with social implications).

This abandonment of the least competitive industries, previously protected, together with the social institutions related to them, took place simultaneously with other complementary policies to boost its production system from a technological perspective. The United States was, and is, the country with the highest investment in basic research in the world[11] but was technologically lagging in relation to the performance of other countries which also used the results of such basic research for their own technology development.

As mentioned, until the 70's, the United States was the country with the largest investment in basic R&D in the world but also the country with the most dynamic industries to incorporate those research results with productive logic. From that decade on, the productive and technological development of reconstructed economies made basic research results obtained with U.S. investments be largely accessible to competing countries.[12] Thus, it became necessary to make the scientific and social resources of that country available exclusively to the development of the American capital.

In that context, in the early 80's, the United States modified its legislation on intellectual property as part of a more comprehensive change. As Correa (1988, p. 16) states: "Various proposals have been made in the United States to reverse what is considered a situation of imbalance of scientific and technological information flows (outwards), including the restriction on information flows abroad and stricter controls on high technology exports... Intellectual property is... another tool which the international strategy of the United States intends to use, in the context of rising technological protectionism, in order to improve the control of domestically developed technology."

Two central changes to intellectual property with the same technological orientation should be mentioned. The first one sought to limit the use of basic science results, obtained with American taxes, by companies from other countries. The second measure intended to maintain the advantage in the activities in which the country already had supremacy and to develop commercially, from the American scientific institutions, new technologies with the greatest transforming potential: information and communication

[11] For the time of the reform, Correa (1988, p. 14) states that: "The United States spends on R&D more than Japan, the Federal Republic of Germany, France and Great Britain together, which accounts for about four-fifths of the U.S. spending. In fact, the United States still has the largest installed and potential R&D base in the world."

[12] Correa (1988, p. 16) states, in reference to the American scientific and technological potential of the time, that it: "... proved apparently insufficient or inadequate to resist foreign competition, particularly of Japan and some new industrialized countries (NICs) in high and medium technology areas... The dissemination of knowledge based on American R&D would have allowed, according to a linear interpretation of the R&D-innovation relation (Kodama, 1988), firms from Japan and other countries to achieve notable market successes without bearing their costs."

technologies, microelectronics, semiconductors and biotechnology (and then also nanotechnology).

To this end, on the one hand, "the intellectual property regime" was modified (Coriat, 2008), making basic research results (previously widely spread through publications) patentable. This was achieved by making the difference between "invention" and "discovery" (Bergel, 1999) more vague and the need to show the "industrial application" of research results less rigorous.[13]

An outstanding characteristic of inventions based on new technological paradigms is that, unlike those generated at the capital financial/scale differentiation stage, they could be obtained with direct productive application by universities and teams of public research institutions.

This represented a substantial difference in relation to previous historical stages of capitalism, at which inventions could only take productive form in big industries (chemical, steel and other heavy industries). Now, opportunities opened up for "brain-intensive" companies.

ICTs and biotechnology, whose research results had almost negligible reproduction costs, were considered technologies representing the future. As Drahos and Braithwaite (2004) argue, the United States boosted changes in international intellectual property legislation through the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which: "... has a crucial harmonising impact on intellectual property regulation because it sets detailed standards of intellectual property law that will profoundly affect the ownership of two significant technologies in the 21st century – digital technology and biotechnology."

In ICTs and biotechnology, the United States had, and sought to maintain, international superiority,[14] which was declining in other high-tech areas.[15] Therefore, it needed to plan ahead in order to avoid the catch-up process which it had undergone in other fields due to copying or imitation,[16] and reforms in the intellectual property area seemed to be the necessary path to take.

Correa adds that: "A report by the United States Academy of Science and the Council of Foreign Relations observes that scientific research conducted in national universities and laboratories has become essential for industrial productivity and competitiveness. Therefore, the traditional accessibility of foreigners to the American educational and research system is increasingly questioned."[17]

---

[13] In this way, the legal protection included knowledge which used to be publicly accessible, such as: biological findings and information obtained with new biotechnology tools, genetically modified plants and animals, and microorganisms modified with genetic engineering methods. Also, algorithms of merely potential use in software (but of no demonstrable industrial utility) were protected and the copyright scope was extended to the "entertainment industry."

[14] As Correa (1988, p. 18) states: "By the way, the U.S. competitive disadvantage is neither general nor, probably, irreversible. In software, its superiority is undisputed, despite the higher productivity of Japanese programmers; in biotechnology, it still maintains a disputed leading position in research and production, based on the great efforts made."

[15] It should be recalled that then high-technology industries included aircraft and spacecraft, office and computing machinery, electronics and components, drugs, electrical machinery and apparatus.

[16] As in the cases of Japan with electronics and pharmaceuticals; Korea with chips, semiconductors and chemicals; and India, Brazil and other Latin American countries with the production of generics.

[17] While changes in the U.S. patent system in principle did not involve changes in other countries' patent systems, as stated by Coriat (2008): "... the law regulating commerce in the United States included a special section on intellectual property, Section 301. This provision obliges the U.S. State Secretary of

In line with those rulings establishing a legal precedent on the extension of the patentability of basic scientific research results, in 1980 the Bayh-Dole University and Small Business Patent Procedure Act was passed.[18]

According to the objectives of the Law, a new productive profile of small technology companies was sought, as opposed to large economic conglomerates of more traditional behavior. To that end, the transfer of public research results to small companies would be favored and such small companies would be directly established through spin-off processes involving university researchers transformed into businessmen.

In spite of the above-mentioned expected promotion of small companies, as a result of the implementation of neoliberal policies, in absolute terms the business organizations most favoured by public research results through the Bayh-Dole Act were the large companies already consolidated. They benefited through two mechanisms:

- On the one hand, while the Law's promotion of Small Business intended to explicitly benefit small businesses and non-profit organizations, as opposed to large State contractors and industrial groups, in order to prevent the creation or consolidation of monopolies, this was not possible to be sustained due to the latter's lobby. According to Henderson and Smith (2002:3): "In 1983, Bayh-Dole's scope was expanded through a Memorandum to the Heads of Executive Departments and Agencies to include large businesses. In the memorandum, President Reagan directed agencies to treat all inventions resulting from federally-funded research in the manner prescribed under the Bayh-Dole Act, an action which was later endorsed by Congress in a 1984 housekeeping provision." (underline added).

  Thus, any consideration of the Bayh-Dole Act as a "model for the creation of businesses" has no real basis.

- On the other hand, there is another more essential mechanism through which large corporations were benefited. As Marcia Angell (2006:19) states when referring to most new drugs appeared on the market in recent years and sold by large pharmaceutical companies: "... they came from research conducted in academic institutions, small biotech companies or National Institutes of Health (NIH), funded with the money of taxpayers." In other words, with no need to benefit large groups directly with public funds, technologically enhanced capital is the main

---

Commerce to establish every year a list of countries which may have violated the intellectual property law to the detriment of American companies, estimating the damage which may have been caused. That list must be sent to the Congress and, once there, reasons must be provided why there was no retaliation against those countries."

[18] "The Bayh-Dole Act requires institutions that retain title to inventions and patent them to show a preference in their licensing activities for small companies and to require that products to be sold in the United States be manufactured in the United States. The government retains the rights to practice the invention on a royalty-free basis and retains march-in rights to ensure that important inventions are commercially developed. Also, the Bayh-Dole Act specifies that any income derived from the licensing of inventions be used to support further research and education, support patent protection for other discoveries with commercial application, and provide an incentive to researchers to participate in these activities." (Severson, 2000:3).

beneficiary of the protection of public research results and their licensing.[19]

It could be said that the "heaven" of ("brain-intensive") small technology companies is the "exit strategy" of being acquired by or having as a contractor a large corporation which boosts their developments. Indeed, generally if successful, small and medium-sized companies created by the Bayh-Dole Act end up integrating their technology capabilities into the pipeline of companies of technologically enhanced capital.

Something similar occurs in the case of public research institutes: their greatest technological achievements are related to the fact that their technologies are adopted by multinational companies which can spread their research results worldwide.[20]

Large corporations are the ones which most invest in technology in absolute terms but are not "brain-intensive" companies because the specificity with which they enhance the results of the whole system does not consist only of such a trait. Let's refer to Angell's example of pharmaceutical industries. Pharmaceutical companies invest enormous amounts of money in R&D, but that is not their main investment area. Their multimillionaire capacity to invest in mega portfolios of R&D projects is just a part of their investment in production, publicity, protection and official regulation costs.[21]

The "spontaneous" relation between academia, small technology companies and large corporations is based on and fostered by public investments of billions of dollars in R&D (as in the case of the investments by the National Institutes of Health or the investments in the Silicon Valley for the development of military devices).[22]

However, there is no possibility that a small or medium-sized business, or a public research institute, may leave the structure of subsystems established by technologically

---

[19] Angell, Chief Editor of the New England Journal of Medicine and member of the Harvard Medical School's Department of Social Medicine, states that: "The Bayh-Dole Act gave a big boost to the new biotechnology industry, as well as to large pharmaceutical companies. There was rapid proliferation of small biotech companies, founded by university researchers for the promotion of their discoveries. These companies are now associated with the major academic research institutions and often work on the initial stages in the development of drugs, hoping to enter into lucrative agreements with pharmaceutical companies which sell new drugs... These laws imply that pharmaceutical companies no longer need to conduct their own research to find new drugs, and very few of the largest ones do so. To such an end, they increasingly turn to academic research, small biotech companies and the NIH. At least one third of the drugs marketed by the large pharmaceutical companies comes from licenses granted by universities or small biotech companies, which tend to be more innovative." (Angell, 2009:29-30).

[20] Neither small technology companies nor public research institutes can give a world productive shape to the technologies obtained by them as a result of their research work. They cannot protect them, meet the regulatory conditions for their release, produce them efficiently, promote them by advertising, and disseminate them through commercial channels worldwide.

[21] Just to put a number on this explanation, protecting an invention through the patent system in the entire world could be more than US$ 200,000. Then, you must add monitoring and maintenance costs. In addition, financial backing will be needed to litigate in those countries where infringers are actually found out. These lawsuits cost millions of dollars. On the other hand, products must be approved by the regulatory authorities. These processes take years and involve great expenses. Overall, it is estimated that maintaining the portfolio of projects which are part of the pipeline a pharmaceutical company is about US$ 800 million.

[22] In fact, as mentioned by Correa (1988, p. 14), for that period of institutional reform: "The Pentagon's share in the national R&D budget increased from 24% in 1981 to 55% in 1987."

enhanced capital. To take productive form, any public research, whether begun by a small company or not, must enter the enhancement strategy of large companies.[23]

Bearing in mind this situation, which is intelligible only by understanding the essence of the operation of technologically enhanced capital, it is possible to understand that the Laws of Innovation and the modification of the intellectual property legislation were a requirement of the enhanced capital itself, when it needed restructuring, to extend its competitive capabilities. The Laws of Innovation favor the enhancement of capital by making the capacities generated with public funds available to large companies.

The change in the legislation was not intended to foster research but to allow it to be exploited within the United States by American companies for all the world. It was not true that, until the Bayh-Dole Act, research results were not productively used; the problem was that other countries used them with the same efficiency at a time when new "barriers" to technology competition were needed.

## 5. Consequences for Countries Seeking Development

In order to gain access to the opportunities which are opened up to large corporations by capitals of lower hierarchy scattered around the world, and which differentiated capitals take and seize, it is necessary that other countries consider as theirs the need for the institutional and policy reforms currently implemented by countries with differentiated capital.

In their countries of origin, large corporations already have the institutional system and legislation tailored to their needs, explaining that such changes are for the "common good." Now, it is necessary to do the same in the rest of the world.

As shown above in the analysis of the U.S. case, those institutional arrangements and policy reforms were basically related to the possibility of making the country's scientific and economic resources available to the technologically enhanced capital. Such a situation needed to be replicated in the rest of the world, and that could only be achieved through an international rule allowing for its global consolidation.

A notable example is the "harmonization" in international law through the TRIPS Agreement.

Such a "harmonization" basically proposed to homologate the intellectual property laws of countries with differentiated capital in countries seeking development, extending rights in favor of holders (technology generators) and widening the scope of what is patentable.[24]

It is interesting to note that the World Trade Organization, which administers the TRIPS Agreement, also administers other multilateral agreements, including the General Agreement on Tariffs and Trade (GATT). According to Tussie (1998), this Agreement: "... is (by far) the international counterpart of the U.S. tariff policy."[25]

---

[23] And in fact entrepreneurs and venture capitalists know that "heaven" for a small technology business is to be acquired by a large company. Therefore, in recent years, literature on "exit strategies" for business enterprises has proliferated.

[24] As Lengyel and Bottino (2006, p. 71) stated: "The case of the TRIPS Agreement is paradigmatic... as it essentially led to the adoption of specific rules... defined by developed countries, and smoothly transplanted provisions prevailing in those countries."

[25] The GATT is presented as an instrument tending to free trade, with its consequent ambition of having universal benefits. However, it is tailored to countries with differentiated capital, contributing to

The TRIPS Agreement was not voluntarily created as intended by the World Intellectual Property Organization (WIPO) but in the context of a "negotiation" established by the WTO in the Uruguay Round.[26] In other words, the TRIPS Agreement was compulsively negotiated in conjunction with the trade conditions which countries seeking development faced to export their commodities and light industry goods (essential for them) to developed markets.

In fact, countries with differentiated capital required to merge intellectual property negotiations with international trade. In this way, the weakest countries needed to improve their position in textiles and agriculture as: "Both issues did not fall under GATT rules and disciplines and, therefore, incorporating them was a systemic priority." (Valle, 2007). Thus, many negotiating strategies of less technologically developed countries focused on these issues and neglected the long-term importance of the TRIPS Agreement.[27]

After the merge of intellectual property with international trade in the negotiation, a system called "single undertaking" was implemented, through which: "No part of the Draft Final Act was considered agreed until the entire package was agreed" (Drahos and Braithwaite, 2004).

The barrier which intellectual property laws tailored to countries with technologically differentiated capital imply to the technological progress of countries seeking development cannot be considered casual. At the time of reaching the TRIPS Agreement: "Developing countries had acquired skills that threatened those at the top of an international hierarchy of pharmaceutical production – the US, Japan, Germany and the UK. They were raising issues that no global knowledge cartel wanted aired." (Drahos and Braithwaite, 2004).

If considered in some detail, it is possible to observe that the sectors which adapted intellectual property rights to the expansion needs of technologically differentiated capitals have been the ones which promoted global "harmonization": the American, European and Japanese pharmaceutical industries; the American and Japanese microchip production industries; the Motion Picture Association, record companies and entertainment industries in general; the European food companies related to geographical indications and appellations of origin; etc.[28]

Nevertheless, DCs presented such an update as a form of integration into the world and legal security which promotes innovation. In general terms, it is often held that greater IP protection, harmonized with the highest standards of the IP legislation of countries

---

liberalizing inter-industrial trade but becoming protectionist, for example, in a sector like agriculture, which is: "... protected in Europe and the United States, for strategic, political and social reasons" (Tussie, 1998, p. 35). The same happens in the case of textiles, iron and steel, and processed agricultural products (Tussie, 1998, p. 43).

[26] Before the TRIPS Agreement, international IP aspects were decided in the WIPO, which, as a specialized agency of the system of United Nations organizations for the development of an international IP system, has no binding force. Given its operational characteristics, the WIPO was the context chosen by developing countries to settle IP disputes. (Lengyel and Bottino, 2006).

[27] As stated by Antonio Trombetta, an Argentine negotiator: "Many of the obligations in the TRIPS Agreement have never been accepted at the Group's negotiating table; instead, they were taken, in 1994, as part of the package concluded in the Uruguay Round" (Valle, 2007).

[28] Particularly strong was the lobby of the American pharmaceutical industry. While pressure was exercised through the Intellectual Property Committee, the Pharmaceutical Manufacturers Association is: "... one of the most active lobbies for patent protection in the United States. It was at its request that the U.S. Government brought several actions against developing countries under section 301 of the U.S. Trade Act." (Correa, 1988, p.12).

with technologically differentiated capital, will bring us closer to the world as it gives a better impression of legal certainty which will encourage greater R&D since risk investments are protected.

But if the harmonization with the TRIPS Agreement was expected to have a negative impact on those national industries, then why was it accepted?

It is understood to have been accepted because in a single-undertaking international trade negotiation each country negotiates the interests of its predominant or strategic capital.[29]

As seen, a central component of the strategic capital of countries with differentiated capital is technology capital. On the other hand, for countries seeking development, predominant or strategic capital is the capital of commodity exports (including industrial commodities such as billet in the steel industry, polyethylene in the petrochemical industry, paper pulp in the cellulose industry, etc.), as well as the capital of industrial import substitution oriented to the domestic market (of low technology complexity but labor-intensive). In Argentina, particularly, not adhering to the TRIPS Agreement meant being subject to trade distortions and discrimination in textiles and agricultural products, for example.

The expansion or defensive support conditions of national predominat or strategic productive forces are the ones which determine the legal arrangements shown as necessary for each nation. Foreign technologically differentiated capitals seek to achieve further and greater protection on their strategic industries. In contrast, the predominant or strategic capital of countries seeking development is not technologically expansive: it is either reproductive (thus intending to import technologies quickly while trying to pay the lowest possible royalties) or technologically defensive (i.e. it occupies the least profitable sectors for technologically differentiated capital).[30]

As an expression of this contradiction, the national IP laws of countries seeking development adhere to international agreements. However, at the same time, as a "defensive strategy," these countries try to maintain the greatest room for maneuver in those aspects which international agreements leave to national laws (Valley, 2007).

In this sense, many times in order to defend certain interests of national capitals (not necessarily relating to the development of a technology industry), the national laws of countries seeking development seem to be "anachronistic," "a little disrespectful" for or "deviating" from the IP legislation of countries with differentiated capital. For example, Argentina did not adhere to the 1991 UPOV Convention (it remained adhered to the 1978 version), is not a party to the Patent Cooperation Treaty (PCT), maintains a conventional differentiation between "discovery" and "invention," and also firmly requires the fulfillment of the "inventive step" and "industrial application" requirements.[31]

---

[29] "Predominant or strategic capital" means the capital related to production sectors on which the performance of an entire national economy largely depends.

[30] We insist on the following: It is not that in countries seeking development there are no sectors or companies that, against all difficulties, manage to compete internationally in technology developments. They simply fail to be capable of transforming the entire economy and, due to their size, are not "strategic" sectors of those countries.

[31] Although it cannot be proved in any other way than with the low efficiency of results, we argue that another form of "defensive strategy" in intellectual property for countries seeking development is by limiting the "police power" of IP law enforcement bodies.

To claim that by changing IP laws the productive profile is changed through the creation of greater incentives to R&D investment is not to understand that the institutional system related to technology development is determined by the interests of national predominant or strategic capitals. These, as already mentioned, are not technologically expansive in all countries.

## 6. Conclusions and Final Thoughts

The mainstream conceptual proposition states that the difference between economies would not be qualitative but mainly cultural. There woud be neither external limits nor "protectionist barriers" to the development of countries.

From this perspective, the valuable theory should be the one which allows to characterize and analyze the solutions found and the institutional organization designed in countries of greater wealth and development. Less developed countries should be "practically intelligent" enough to know which of those "evident examples" of greater development to follow and how to do so in order to replicate them at home.

While those conceptual frameworks recognize all the national limits of Latin American countries, resulted from our historical and economic situation, it is considered that all the immediate conditions to take a "qualitative leap" would be met. These conditions would be based on the possibility that STI components change their "cultural" way of operating, both in the decision-making process of companies, research institutes, universities, etc., and in the articulation that they could achieve, as well as in the development of emerging innovative clusters based on the example of successful cases.

Based on the mainstream conceptions on STI, it could be said that the atavism and characteristics of our cultural idiosyncrasy, translated into institutional and business dysfunctions, are largely responsible for the national catch-up.

However, from the above development, it can be observed that there are technological barriers for countries seeking development to have access to the technologies which are part of the new paradigms. Therefore, what is shown as a "cultural" difference between countries is actually a difference which the States of the most technologically developed countries seek to create and maintain.

As observed in the case of the United States, those laws which were intended to promote technological change in the new technological paradigms on the basis of the increasing public-private articulation and the creation of technology companies in fact were promoted by and benefited the most concentrated sectors of production.

Insofar as it is not understood that the role of the State is the expression of the needs of the nationally dominant capital and that just in a few economies capital, and therefore the role of the State, is technologically expansive, when the mainstream conceptual frameworks declaim the involvement of the State in countries seeking development, they are actually condemning them to impotence and inefficiency.

Particularly, in countries seeking development, on the basis of the policy recommendations arising from the analytical framework of the national system of innovation, laws are created first without a change in the dependent productive structure. Then, when it is verified that in those countries these laws do not deliver the same results as in DCs, the national cultural incapacity of less developed countries is blamed for such a low impact: lack of entrepreneurial culture, researchers having an

“ivory tower” attitude or a corporate attitude, lack of risk spirit, disrespect for institutions and laws, etc.

This does not mean that the legislation or the institutional system do not fulfill any role. What is meant is that, in countries with technologically expansive capital, laws supporting and speeding up these processes of institutional change are implemented. Therefore, in these countries, important empirical successes related to changes in the legislation are observed and laws are considered the “determining factor” or “cause” of their technology development.

As institutions tailored to the needs of technologically enhanced capitals collaborate by making all national resources available to them, in countries seeking development through legislations imitating the laws of DCs, the same result is obtained in favor of large corporations from other countries. The Laws of Innovation and IP, implemented exogenously for countries with no technologically expansive capital, make these countries’ most promising research results available to large corporations and thus contribute to the consolidation of an unbalanced social structure and a non-sustainable production structure.

Therefore, from the historical experience it can be concluded that countries seeking development need a State which can create new technological sectors until the private sector is sufficiently strong.

Therefore, the conviction that the main challenge for countries seeking development is not only technological progress, management capability, engineering cleverness and business entrepreneurship is reasserted. The need for and promise of development contained in the creation of endogenous circuits of technology innovation are still alive, but the difficulties of technology development are not the cause for underdevelopment but its expression.

Basically, the need for least developed countries to recreate their reality from a conceptual viewpoint and reinvent themselves from a liberating perspective seems to prevail.

In conclusion, the role of the State is certainly central but as transformer of its reality. As in the case of developed countries, the State must guide its society towards development and sometimes needs to oppose short-term “private initiatives” or “private initiatives” linked to static advantages which can only be the basis of fragmented societies and economies.

Finally, this paper argues that countries seeking development do not find sound theoretical foundations on which to formulate their STI policies with the transforming contents they pursue. This is due to the fact that they intend to adopt and adapt the theoretical frameworks and systems created in developed countries and not a critical one derived from their needs, risking their destiny in the social and economic development.

## Bibliographical References


-- **Angell, Marcia:** "La Verdad acerca de la Industria Farmacéutica. Cómo nos engaña y qué hacer al respecto". Grupo Editorial Norma. Bogotá, 2006.

-- **Atkinson, Anthony B. y Stiglitz, Joseph E.:** "*A New View of Technological Change",* The Economic Journal, September 1969, pág. 573-578.

-- **Banda, Enric**: "Notas para la conferencia: La política científica y de formación de recursos humanos en economías abiertas. Lecciones de la experiencia europea para la Argentina.". Artículo presentado en el Seminario: "Políticas para fortalecer el Sistema Nacional de Innovación: La experiencia internacional y el camino emprendido por la Argentina". Buenos Aires, 6-7 de septiembre de 1999.

-- **Banco Interamericano de Desarrollo (BID): "**Modernización del Estado. Documento de estrategia". Documento revisado por el Directorio Ejecutivo del Banco (GN -2235-1) el 23 de julio de 2003, Washington, D.C.. Disponible en el sitio del BID http://www.iadb.org/sds/publication/publication_3437_s.htm (fecha de acceso: octubre de 2008)

-- **Banco Interamericano de Desarrollo (BID):** "Competitividad. Documento de estrategia". Agosto de 2003, Washington, D.C. Documento disponible en el sitio del BID http://www.iadb.org/document.cfm?id=369082 (fecha de acceso: octubre de 2008)

-- **Bercovich, Néstor y Katz, Jorge:** "Biotecnologia y Economia Política: estúdios del caso Argentino". Centro Editor de América Latina. Buenos Aires, 1990.

-- **Bergel, Salvador D.:** "Requisitos y Excepciones a la Patentabilidad. Invenciones biotecnológicas", articulo publicado en Correa, Carlos (Coord.): "Derecho de Patentes. El nuevo régimen legal de las invenciones y los modelos de utilidad". Ed. Ciudad Argentina. Buenos Aires, 1999.

-- **Bisang, Roberto** (2003): "Apertura Económica, Innovación y Estructura Productiva: La aplicación de biotecnología en la producción agrícola pampeana.", *Desarrollo Económico,* vol. 43, nro. 171, 413-440

-- **Bresser Pereira, Luiz Carlos:** "La Reforma del Estado de los Años Noventa. Lógica y Mecanismos de Control". Desarrollo Económico, vol. 38, Nº 150 (julio-septiembre de 1998), p. 517-550.

-- **Cardoso, Fernando H. y Faletto, Enzo**: "Dependencia y Desarrollo en América Latina". Siglo XXI, México, 1969.

-- **Coase, R. H**.: "La Empresa, el Mercado y la Ley". Alianza Editorial. Madrid. 1994

-- **Coriat, Benjamin:** "El Régimen de Propiedad Intelectual". Realidad Económica. Nº 233, 1-15 de febrero del 2008, p. 49-65.

-- **Correa, Carlos:** "Propiedad Intelectual, Innovación Tecnológica y Comercio Internacional". Centro de Economía Internacional. Buenos Aires, 1988.

-- **Dagnino, Renato y Thomas, Hernán**: "La política Científica y Tecnológica en América Latina: nuevos escenarios y el papel de la comunidad de investigación". Revista REDES, Vol. 6, Nº 13, pp. 49-74, mayo de 1999.

-- **Dahlman, Carl y Nelson, Richard**: "Social Absortion Capability, National Innovation System and Economic Development". Paper Prepared for the United Nations University Institute for New Technologies (UNU/INTECH), Maastricht, Junio 21-23 de 1993.

-- **Drahos, Peter y Braithwaite, John:** "*Who Owns the Knowledge Economy? Political organising behind the TRIPs"*. The Corner House. Briefing Paper 32. Septiembre, 2004.

-- **Dosi, Giovanni**: "Paradigmas Tecnológicos y Trayectorias Tecnológicas. La dirección y los determinantes del cambio tecnológico y la transformación de la economía". En François Chesnais y Julio César Neffa (compiladores): "Ciencia, Tecnología y Crecimiento Económico". CIEL-PIETTE CONICET. Serie Trabajo y Sociedad. 2003.

-- **Freeman, Chris**: "The 'Nacional System of Innovation' in historical perspective". En Cambridge Journal of Economics, 1995. 19. 5-24 (traducción de Alicia Calvo).

-- **Edquist, Charles:** "*System of Innovation Approaches – Their Emergente and Characteristics".* Pinter Publishers/Cassell Academic, 1997

-- **Edquist, Charles:** "*System of Innovation for Development (SID)".* Background Paper for Chapter I: 'Competitiveness, Innovation and Learning: Analytical Framework' for the UNIDO World Industrial Development Report (WIDR), 2001.

-- **FINEP:** "The Brazilian Innovation Agency". Publicación disponible en www.finep.gov.br (fecha de acceso: octubre de 2008)

-- **Gore, Charles**: "Development Strategy in East Asian Newly Industrializing Economies: The Experience of Post War Japan, 1953-1973". Naciones Unidas. Conference on Trade and Development , Ginebra, Suiza, 1994.

-- **Gutiérrez, Marta:** "Políticas en Genética Vegetal". Artículo presente en "El Desarrollo Agropecuario Pampeano", Osvaldo Barsky (editor). Grupo Editor Latinoamericano. Buenos Aires, 1991.

-- **Haggard, Stephan y Kim, Euysung**: "The Sources of East Asia's Economic Growth". Acces Asia Review. Verano de 1997. Páginas 31-64

-- **Ha-Joon Chan**: "Intellectual Property Rights and Economic Development – Historical Lessons and Emerging Issues". *Third World Network*. Malaysia. 2000.

-- **Henderson, Jennifer A. y Smith, John J.:** "Academia, Industry and the Bayh-Dole Act: An Implied Duty to Commercialize", octubre de 2002. Artículo disponible en http://www.autm.net/aboutTT/aboutTT_supportInfo.cfm (fecha de acceso: octubre de 2008).

-- **Jonhson, Björn y Lundvall, Bengt-Ake**, "*Institucional Learning and Nacional System of Innovation*". Artículo presentado en la conferencia sobre "*Strategies of Flexibilization in Western Europe: Techno-Economic and Socio.Political Restructuring in the 1980's*". Roskilde Universitetscenter, 6-10 de abril de 1988.

-- **Katz, Jorge**: "Cambio Tecnológico en la Industria Metalmecánica Latinoamericana. Resultado de un Programa de Estudios de Casos". Revista de la CEPAL, Santiago de Chile, 1983.

-- **Lengyel, Miguel F. y Bottino, Gabriel:** "Los Países de América Latina, el Sistema Mundial de Comercio y el Desarrollo: el caso de la propiedad intelectual.". En "Propiedad Intelectual y Tecnología". Editorial La Ley. Buenos Aires. 2006.

-- **Levín, Pablo**: "El Capital Tecnológico". Ed. Catálogos, 1997, Buenos Aires.

-- **Leydesdorff, Loet y Etzkowitz, Henry**: "The Transformation of University-industry-government Relations". En Electronic Journal of Sociology, 2001. ISSN: 1198 3655.

-- **Linsu Kim**: "*Imitation to Innovation: The Dynamics of Korea's Technological Learning*". Harvard Business School Press. Boston, 1997.

-- **López, Andrés**: "La Reciente Literatura sobre la Economía del Cambio Tecnológico y la Innovación: una guía temática". En I+D. Revista de Industria y Desarrollo. Año 1. Nº 3. Buenos Aires, septiembre de 1998.

-- **López, Andrés**: "El modelo agroexportador argentino a la luz del enfoque del sistema nacional de innovación", Desarrollo Económico, Vol 42, Nº 166, Julio / Septiembre 2002.

-- **Lundvall, Bengt-Ake; Johnson, Björn; Sloth Andersen, Esben y Dalum, Bent:** "*National System of Production, Innovation and Competence Building".* En *Research Policy*, Nº 31, 2002, p. 213-231.

-- **Maddison, Angus:** "Explaining the Economic Performance of Nations, 1820-1989", publicado en, Angus Maddison: "Explaining the Economic Performance of Nations" (Hants, England: Edward Elgar Press, 1995)

-- **Mendes Pereira, João Márcio: "**El Banco Mundial y la reforma del Estado: ¿más allá del Consenso de Washington?". Artículo tomado de La Jiribilla, Revista Digital de Cultura Cubana. La Habana, Año V, 9-15 de septiembre de 2006 (http://www.lajiribilla.cu/2006/n279_09/279_05.html )

-- **Ministerio de Ciencia, Tecnología e Innovación Productiva:** "Plan Nacional de Ciencia, Tecnología e Innovación 2012-2015 'Hacia una Argentina Innovadora". http://www.mincyt.gov.ar/multimedia/archivo/archivos/PNCTI2012-2015.pdf

-- **Moncada Paternò Castello, Pietro; Rojo de la Viesca, Jaime y Cahill, Eamon**: "La gestión de la propiedad intelectual en la investigación financiada con fondos públicos", The Institute for Prospective Technological Studies Report, Nº 26, Julio de 1998.

-- **Nelsen, Lita**: "*The Rise of Intellectual Property Protection in The American University*", *Science* 6 March 1998: Vol. 279. no. 5356, pp. 1460 – 1461

-- **Obschatko, Edith y Piñeiro, Martín**: "Agricultura pampeana: cambio tecnológico y sector privado". Buenos Aires, CISEA, 1986.

-- **Orlansky, Dora:** "El Concepto de Desarrollo y las Reformas Estatales: Visiones de los Noventa". Trabajo que forma parte del Subsidio UBACYT SO62, Instituto de Investigaciones Gino Germani (UBA). Una versión preliminar de este trabajo fue presentada en el TERCER CONGRESO ARGENTINO DE ADMINISTRACIÓN PÚBLICA, Sociedad, Estado y Administración, San Miguel de Tucumán, Junio 2-4 2005.

-- **Penrose, Edith T.**: "La Economía del Sistema Internacional de Patentes". Siglo Veintiuno Editores. Méjico. 1974.

-- **Perez, Carlota:** "Revoluciones Tecnológicas Y Capital Financiero: La Dinámica de Las Grandes Burbujas Financieras Y Las Épocas de Bonanza". Siglo Veintiuno Editores. Méjico. 2004

-- **Porta, Fernando y Fernández Bugna, Cecilia**: "El Crecimiento reciente de la Industria Argentina. Nuevo régimen sin cambio estructural". Revista Realidad Económica, Nº 233m, enero/febrero de 2008.

-- **Rutan, Vernon:** "*Is War Necessary for Economic Growth?: Military Procurement and Technology Development*". Oxford University Press. New York, 2006.

-- **Sábato, Jorge Federico:** "La Pampa Pródiga : Claves de una frustración. El agro pampeano argentino y la adopción de tecnología entre 1950 y 1978. Un análisis a través del estudio del maíz." Buenos Aires, CISEA, 1980.

-- **Schumpeter, Joseph Alois:** "Teoría del Desenvolvimiento Económico", Fondo de Cultura Económica. Méjico, 1978. 5 Ed.

-- **Schumpeter, Joseph Alois:** "Capitalismo, socialismo y democracia", Ed. Aguilar, México, 1952.

-- **Severson, James A.:** "Hearing Testimoy". *Oversight hearing on "Gene Patent and Other Genomic Inventions", House Committee in the Judiciary, Subcommittee on Courts and Intellectual Property,* 13 de Julio de 2000.

-- **Solow, Robert**: "*A Contribution to the Theory of Economic Growth*," Quarterly Journal of Economics 70, no. 1 (1956): 65-94.

-- **Stiglitz, Joseph:** "La Economía del Sector Público", Ed. Antoni Bosch, Barcelona, 2002.

-- **Sutz, Judith y Arocena, Rodrigo:** "Mirando los Sistemas Nacionales de Innovación desde el Sur". Trabajo presentado en la Conferencia "Sistemas Nacionales de Innovación, Dinámica Industrial y Políticas de Innovación", organizada por la Danish Reseca Unit on the Industrial Dynamics (DRUID). Rebild, Dinamarca, 9-12 de junio de 1999.

-- **Tussie, Diana:** "Los Países Menos Desarrollados y el Sistema de Comercio Internacional". Fondo de Cultural Económica, Méjico. 1988.

-- **Valle, Ana Inés:** "Reportaje a Antonio Trombetta", en MPI Newletter (Número 1). Buenos Aires, Argentina (Diciembre 2007).

-- **Williamson, Oliver E.:** "Las Instituciones Económicas del Capitalismo". Fondo de Cultura Económica, México. 1989.

-- **Zukerfeld, Mariano:** "La reciente expansión de la Propiedad Intelectual: una visión de conjunto"