Comparative Innovation and State Capacity in Brazil, China, and Argentina

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Abstract

The state capacity to formulate, manage, and implement (and in some cases to evaluate) science, technology, and innovation policy is the subject of the present work. The goal is to compare state and policy capacity in Brazil, China, and Argentina to point out comparative institutional advantages and disadvantages.

One of the study's main conclusions is the existence of a structured consensus on what sectors the enterprising state should incentivize and promote, on where the frontier is located, and whether these countries are at the frontier of innovation depends on: the existence of a rearguard of institutions capable of undertaking prospective (and retrospective) studies that are effectively considered in the decision-making process; the continuous exercise of foresight or technological foresight, subject to processes of periodic revision; the capacity to take account of conflicts of interest, but equally to neutralize them when building structured consensus; and finally to count on a well-established but effective financial innovation system. What is at issue is not a continuous set of abilities or expertise but a variety of decision-making processes on long-term strategy and coordination in the development and implementation of technology policies.

Resumo

As capacidades estatais de formular, gerir e implementar (em alguns casos de avaliar) as políticas de ciência, tecnologia e inovação são o objeto do presente trabalho. O objetivo é comparar as capacidades estatais e políticas do Brasil, China e Argentina para abalizar vantagens e desvantagens comparativas institucionais.

Uma das principais conclusões do estudo é que a existência de um consenso estruturado sobre que setores devem ser incentivados e promovidos pelo Estado empreendedor, sobre onde se encontra a fronteira, e se esses países se encontram ou não na fronteira da inovação depende: da existência de uma retaguarda de instituições capazes de realizar estudos prospectivos (e retrospectivos) que efetivamente sejam considerados no processo de tomada de decisões; do exercício contínuo de foresight ou de prospectiva tecnológica, sujeito a processos periódicos de revisão; da capacidade de ter em conta os conflitos de interesse, mas igualmente de neutralizá-los quando da construção do consenso estruturado; finalmente de contar com um sistema financeiro de inovação enraizado, mas efetivo. Não se trata de um contínuo de habilidades ou competências e sim de uma variedade de processos de tomada de decisão sobre estratégias de longo prazo, e de coordenação na elaboração e implementação de políticas tecnológicas.

Key words: Innovation System, Developmental State, Compared State Capacities
JEL CLASSIFICATION
O - Economic Development, Technological Change and Growth
O3 Technological Change; Research and Development; Intellectual Property Rights

Executive Summary

State Capacity is "the set of tools and institutions the State disposes to establish goals, transform them into policies and implement them" (…) "the rules of the game that govern political, societal, and economic behavior: the political party system, executive-legislative relations, channels for mediation of interests, conflict resolution; public policies – institutions and strategies that influence decisions on policy, their development, and execution, mapping the mechanisms of intra-governmental coordination or executive coordination". [1]/

In the short Peter Evans´ definition (1993), it is the State's capacity for action. Comparisons in this case are relevant "for looking at how innovation is actually organized and **how it might be organized better**". [2]/

Karo and Kattel (2013) add a very useful definition on policy capacity.

> "Policy capacity emerges from three interlinked policy choices: nature and sources of technical change and innovation; on the ways of **financing** economic growth, in particular technical change; mature of public management to deliver and implement both previous sets of policy choices. It is not a continuum of abilities but rather a **variety of modes** of making policy".[3]/

The most recent literature on innovation and public institutional arrangements for science and technology emphasizes the role of the entrepreneurial states and their fundamental contribution to development policies in middle income countries (but also in developed countries as United States). These positions (Weiss, 2014; Mazzucato, 2013; Block & Keller, 2011; Primi, 2014) [4]/ share a consensus about the role of innovation in catching-up and leap-frogging processes.

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[1] / Celina Souza´s research report to Ipea (Institute of Economic and Applied Research , Ministry of Planning), Compared State Capacities, to be published soon, 2014.

[2] / Peter Evans Introduction in Block, F. e Keller, M.R. – State of Innovation. The U.S. Government´s Role in Technology Development.Paradigm. Publisher. Boulder, London. 2011.

[3] / Karo, E and Kattel, R. – Public Management, Policy Capacity, Innovation and Development. Brazilian Journal of Political Economy, vol. 34, nº 1 (134), pp. 80-102, January-March/2014

[4]/ Weiss, L. America Inc.? Innovation and Enterprise in the National Security State, Cornell University Press, Ithaca and London, 2014; Mazzucato, M., The entrepreneurial Strate, Debunking Public vs. Private Sector Myths; Block, F. and Keller, M.R. op.cit; Primi, A. Promoting Innovation in Latin America – What Countries Have Learned (and What they have not) in Designing and Implementing Innovation and Intellectual Property Policies, University of Maastricht, 2014.

Coriat e Wallerstein (2006) [5]/ contributed to this analysis from a different view point and called the attention to the increasing importance of what they have called a technical paradigm strongly based on science ("science based 2"). In these sectors – where the technical frontier seems to be located, as in biotech and information technologies - two dimensions are crucial: finance (capital markets) and intellectual property (the relevance of patents and the intellectual property system). These two dimensions are interwoven and are embedded in this new scientific paradigm.

Industrial and innovation policies[6] seem to be the key to surpass the threshold of development.

> "the number of *non-western* countries which have become developed is less than ten -- even stretching the categories of "non-western", "countries" and "developed". The list plausibly includes: Japan, Russia, Taiwan, South Korea, Hong Kong, Singapore, Israel. Such a low total suggests that the vast "development industry" created since the Second World War can hardly be counted a success. The non-western success cases had or have two conditions in common: first, external state enemies capable of conquering the territory; second, **a much more active and directive state** than is consistent with prevailing neoclassical development strategies. (Hong Kong is a partial exception to the second condition). Wade, 2014 [7]/

Countries that crossed the threshold can be said to be at the technological frontier and, moreover, mostly can define the technological frontier in some sectors. Middle income countries, however, suffer the perils of being captured by technology traps. Three different situations generally can be found: the position of sectors/companies as suppliers ("subcontractors") in global value chains; sectors/companies with the capacity to equip and leap-frog the frontier; and an intermediate position, where Brazil and China seem to be, some sectors are at the frontier (low-emissions tropical agriculture, deep water oil exploration, small and medium aircraft manufacturing, in the case of Brazil), while other sectors are not competitive.

Wu, Ma e Chu (2010)[8] proposed the concept of secondary innovation, regarding the cases where it seems possible the coexistence of different technical trajectories. When a

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[5] / Coriat, B. and Wenstein, O. - Science-based innovation regimes and institutional arrangements: from science-based "1" to science-based "2" regimes. Towards a new science-based regime? Industrial and innovation. See the seminal article by Pavitt, K. (2005) The Innovation Process. In Fagerberg, J., Mowery, D. and Nelson, R. (eds) The Oxford Handbook of Innovation. Oxford University Press, Oxford**.**

[6] / Inclusive and sustainable, to add two important nowadays dimensions.

[7] / Wade, R. Doing Industrial Policy Better, not Less**,** unpublished manuscript, August 2014. Thanks to Professor Robert Wade to allow me this citation. The importance of external enemies and exceptional political conditions in the eve of catching up processes was pointed out before by Abramovith, A 'Catching-up, Forging Ahead and Falling behind', *The Journal of Economic History,* **46**(2):385-406.

[8] / Wu, X; Ma, R. and Chu, G. (2010) Secondary Innovation: The Experience of Chinese Enterprises in Learning, Innovation and Capability Building. National System for Innovation Management. Teece,D. Dynamic Capabilities & Strategic Management, Oxford 2009. Chapter 1. The Nature and Microfoundations of (Sustainable) Enterprise Performance.

technological trajectory is not entirely defined in one specific sector, countries can advance through alternative paths. However, they tend to come up against the limits related to their technical capacity, when a crisis in the development process tends to occur. As far as these limits are overcome, the country has a competitive advantage with which to forge ahead.[9]

Innovation, and the national innovation system of which it is a part, seems to be the ace in the hole that would allow the country to reach the technological frontier in the sectors where the country could have comparative institutional advantages. This ace in the hole seems probable when **a structuring of consensus** is plausible – on which sectors the entrepreneurial State should promote and incentivize, on where the frontier is located, and whether these countries find themselves, can reach it, or define the innovation frontier.

The process of structuring consensus depends on: the existence of a rearguard of institutions capable of undertaking prospective (and retrospective) studies that are effectively considered in the decision-making process; the continuous exercise of foresight or technological foresight, subject to processes of periodic revision; the capacity to take account of conflicts of interest, but equally to neutralize them when building structured consensus; and finally to count on a well-established but effective financial innovation system. What is at issue is not a continuous set of abilities or expertise but a variety of decision-making processes on long-term strategy and coordination in the development and implementation of political technologies.

Main research outcomes:

• The configuration of the Brazilian NIS seeks to integrate the education, research, and innovation financing systems (BNDES, FINEP, Sectorial Funds). In the Chinese case, financing does not appear in the organization charts of the Innovation System, it happens directly through the banking system. The proximity of agencies with companies, on national, sectorial, and regional levels, assures financing, once companies (all of them) have been evaluated positively in terms of their (effective) contribution to technological and industrial development in China. This is, without a doubt, a difference to be emphasized.

• In the Brazilian context, there is a solid legal framework, the financing of innovation is deeply institutionalized, the resources are available, as well as investment policies. But the needed flexibility to attend to companies does not exist, much less the intersection between supply and demand for funding for innovation. There are many requirements,

[9] / I would add the following: if a specific country over cross the frontier or it is located at the frontier, after a process of secondary innovation; if this process takes into account a particular trajectory and a successful one; if this trajectory reflects its own endowment of resources and capabilities - then this country tends to be able to define the physical and social technologies of this frontier. For the concept of social technologies see Nelson, R. and Sampat, B. What enables rapid economic progress: What are the needed institutions? Research Policy 37 (2008) 1–11

legal frameworks, and controls, especially on the part of the Federal Court of Accounts, while there is a lack of new companies capable of delivering what they promised.

• In the Chinese case, MOST's coordinating role through CASTED and CASS act as think thanks in the role of integrating foresight activities under the same strategic, long-term vision. The results are a greater coordination compared with the case of Brazil.

• The Chinese case as a deep comparative institutional advantage: the architecture of the Chinese innovation system inverts, or subverts, the structure that characterizes the Brazilian and Argentinian systems. The technological innovation that emerges from the actual economic system is at the top of the innovation system and not at its base**.** Private and public research is the not the finish line, but the starting line. The second layer of the system is the advisory apparatus for strategic decisions, performed by research institutes, think thanks, universities, and so forth. The Chinese innovation system is the result of a consensus, a collective process of creating structural consensus.

Introduction:

"Industrial policy can be seen as a strategy of the State, from a medium to long term perspective, with the goal of promoting new technological and industrial capacities in companies of a higher order than already existing in the economy and beyond what so-called market forces could promote. These capacities determine productivity, the quality of products and ability to eliminate product lines or introduce new products or processes and, therefore, determine the capacity of competing with other companies in other economy, especially in the third wave of globalization we are experiencing." (Wade, R. 2012)[10]/

So-called "industrial policies," internationally banned over the course of the 1990s, have recently been taken up again after the most recent economic crises. They tend to be confused with science, technology, and innovation policy, redeeming the basic strategic character of choices and goals, as well as the relevance of governance and coordination in the implementation of these policies. The main focus of our analysis of the innovation axis – in the Project on Comparative State Capacity in Brazil, China, and Argentina – is to reveal these governmental capacities to, not only catch up technologically with more advanced countries, but also especially to leap-frog these countries in certain sectors or areas of knowledge when possible.

The main goal of the innovation axis is, therefore, to analyze the "state capacity" for formulating (and, if possible, implementing) innovation strategies among middle-income, emerging, or developing countries, in the cases of Brazil, China, and Argentina. To do this, it is important, when relevant, to keep in mind, the coalitions that support these strategies, so as to

[10] Wade, R. "The return of industrial policy?" International Review of Applied Economics, March 2012, pgs 223-40)

conceive of a coherent and consistent trajectory, rooted in a long-range perspective, with the goal of overcoming the trap of middle-income countries.[11]

To examine decision-making processes, and when possible implementation as well, concerning science, technology, and innovation policy, one must:

1. Study the complex institutional architecture of national (and international) innovation systems in these countries, where the strategies are developed; which institutions support them and how knowledge is governed or coordinated[12] in Brazil, Argentina, and China, with an emphasis on industrial sectors/complexes such as agribusiness and energy (biofuels);

2. Understand how coordination happens, or not, among the constitutive parts of the system, especially the relationship between those who make decisions and those who back the decision-making – research institutes, think thanks, universities, among others;

3. Examine whether there is an effort to create a forward-looking, prospective vision and foresight;

4. Map the governance structures and power relations that the research project can capture;

5. Compare – in case studies of countries and sectors – the variety of tools at the disposal of the various industrial policies: choosing winners and supporting losers; regulation of competition as solution or problem; regulatory framework; the incentives and disincentives of intellectual property; subsidies, price reductions, government purchases; industrial training and outreach and technical assistance programs for companies, and other tools available in within the scope of the complex institutional web of policy development.

6. And, finally, describe the shared conventions and beliefs behind the perspectives on the future that influence in some way the path and choices that are followed.

We start from the following hypotheses that guide the fieldwork in the three countries:

1. The learning processes that happen inside the so-called National Innovation Systems are not capable of being disassociated from the international experiences in the technological fields in question. As such, the concept of National Innovation System must be considered with global innovation and international training processes. The international experience matters.
2. The institutional diversity that characterizes each case study is relevant in explaining the different trajectories of the countries as they relate to their technological policies.
3. However, geography contains explanatory power, as far as it reveals the particular endowment of productive resources; the industrial chains, while still following the same international standard, show national and local characteristics; the institutions are basically national and local, lending singular qualities that could not be captured under the hypothesis of the globalization of processes and products; finally, history and trajectory also matter (path dependence).

[11]/ Angang, Hu – Collective Presidency, to be published in 2014, mimeo, e Wade, R., ob. cit., 2012.

[12]/ The set of institutions and policies that regulate the production, spread, and protection of knowledge. The proposal emphasizes, based on the comparison between the countries studied, industrial and technology policies, national innovation systems, regulation of competition, the existing system for the protection of intelectual property and the legal framework that defines it.

4. Science, Technology, and Innovation policies have a prospective dimension and reveal innovation strategies for the future in each country. The concerns about a low-carbon emissions economy and the sustainability of development are recurring. These considerations conform to shared beliefs that could be summarized, with special emphasis in the Brazilian case, in promoting "a sustainable development with social inclusion." The case studies in the agricultural and bioenergy/biofuel sectors illustrate this hypothesis.

For fieldwork, the following survey was adopted, reflecting the project's hypotheses:

1) Which vision for the future is contained in the formulation of general objectives and specific policy/program/project being analyzed? To which technological dilemmas or traps in the economy or sector did it seek to respond to or confront? How should the idea of the technological trap of middle-income countries be defined? How does the development of policy face the challenge of overcoming or surpassing the situation of the middle-income country?

2) Which government bodies were involved in its development (institutional architecture)? What role does each play? Which were the main conflicts or controversies between the different government agencies? How were they resolved?

3) How should the set of institutions that regulate the production, dissemination, use and protection of innovation in the economy, in a particular sector, or company be defined?

4) What are the main innovation policies developed? Through which mechanisms or incentives: governmental purchases, subsidies, partial or total exemptions, choice of winners, specific required levels of nationalization, required levels of shared technological content, required partnerships between foreign and domestic companies, and other forms of investment required of companies?

5) How to map the decision-making processes of the policy or strategy being analyzed? Conflicts of interest, coalitions of power, bureaucratic conflicts, power structures? How to evaluate bureaucratic and/or decision-making deadlocks?

6) Where is the knowledge frontier located in the sector being studied; does the country/sector/company find itself on this frontier? Does the country/sector/company define the knowledge frontier in this area? How is/was the sustainability dimension incorporated?

7) Are there institutions that hold major decision-making power? What is this leadership based upon?

8) What other policies/perspectives on the future converge or diverge on currently formulated ones?

Contextualization of the National Innovation System in the countries studied (description of agencies and institutions involved) Brazil, Argentina, and China

LEGAL FRAMEWORK OF THE BRAZILIAN NATIONAL INNOVATION SYSTEM. MAIN LAWS AND ORDERS.

1. Law n. 1.310/15 (01/1951). Creation of CNPq, tasked with the role of coordinating and promoting scientific research in the country.
2. Order n. 29.741 (11/071951). Founding of the Coordination for the Improvement of Higher Education Personnel (present-day CAPES) with the goal of "assuring the existence of specialized personnel in quantities and qualities sufficient for meeting the public and private enterprises that seek the country's development".
3. Order n. 61.056 (24/07/1967). Creation of FINEP – Order n. 1.808 (07/02/1996) approving the FINEP bylaws (Financing of Studies and Projects).
4. Order 91.146 (15/03/1985). Creation of the Ministry of Science and Technology.
5. Law 9257 (09/01/1996). Creation of the National Council on Science and Technology (CCT) as an advisory body to the President's office.
6. Order n. 4.728/9 (06/2003). Approving the bylaws and personnel chart for the CNPq.
7. Law n. 10.973 (02/12/2004) Law of Innovation.
8. Law n. 11.080 (30/12/2004). Creation of the National Council on Industrial Development (CNDI), a collegiate body, regulated by Decree n. 5.353, January 24, 2005, whose task is to propose to the President national policies and specific measures to promote industrial development in the country.
9. Law n. 11.196 (21/11/2005) Law of the Good. Establishes fiscal incentives for technological research and innovation. Order 5.563 (11/10/2005) regulates the Law of Fiscal Incentives for Innovation.
10. Order n. 7.540 (02/11/2011) creates the Greater Brazil Plan. The Order regulates the new CNDI (National Council on Industrial Development, see note 8), responsible for implementation and management of the GBP.

The complex institutional architecture – the most complex and complete as compared to the Argentine and Chinese systems[13] —that characterizes the Brazilian National Innovation System could be described like this (See Diagram 1). This system, like the others (Diagram 2, Argentina and Diagram 3 for China), is characterized by a legal framework that contains laws and orders that were established beginning in 1951, such as the one that creates the National Research Council (CNPq) and the Coordination for the Improvement of Higher Education Personnel, present-day CAPES. In this sense, the formation of a National System of Science and Technology is precocious in Brazil when compared with Argentina.[14] In the case of China, the current configuration is recent, much more recent than the Brazilian one, but the concern with the introduction of innovations blurs itself with China's own millennial culture.[15] The configuration of institutional architectures, compared in the following, turned out to be extremely relevant to understanding the decision-making, governance, and coordination processes in the respective National Innovation Systems.[16]

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[13] / It could be said that the concern with the introduction of innovation stems from earlier periods in Brazil's economic history, in the economic cycles centered on sugar cane and coffee, which are not addressed here. On this point, see Castro, A.B. "Escravos e Senhores nos Engenhos do Brasil: um Estudo sobre os Trabalhos do Açúcar e a Política Econômica dos Senhores", thesis defended in 1976 for doctorate in economics.
Available at http://www.bibliotecadigital.unicamp.br/document/?code=000075896

[14]/ In reality, the concern with the introduction of technological progress was also present during the end of the sugar cane cycle, in the end of the 19th century, still in the Brazilian colonial era, with the transformation of the mills into sugar factory. The introduction of machines for the production of coffee, and the introduction of agronomic research for export products, were undertaken early on by research institutes, such as the Agronomic Institute of Campinas, established in 1887 by Emperor D. Pedro II.

[15]/ See the classic work of Winchester, S. – O Homem que Amava a China, tradução da Companhia das Letras, 2008. Joseph Needham, the scientist who lobed China, published his first volume on the country in 1954 and its 24 volumes continued to be released until after his death in 1995.

[16] / "The National Council on Science and Technology, established by the Greater Brazil Plan, is so constituted: "The CNDI is formed by thirteen ministers, by the president of the National Bank for Social and Economic Development (BNDES) and by fourteen civil society representatives and is tasked with establishing the general strategic outlook and subsidizing the activities of the management system. Competitiveness Councils – the executive committee is the body that will accompany and supervise the establishment of the Greater Brazil Plan, while the Executive Office will handle administration. The two will be under the MDIC's direction. Among the Executive Office's functions are the creation of

Comparing the Argentinian legal framework, which doubtless introduced more recent changes, it is interesting to consider the account of the Secretary of Science, Technology, and Innovation Policies, Fernando Peirano, who notes: "*In terms of the legal framework, two laws exist in Argentina. One from the mid-1990s, which in an unfavorable climate allowed the maintenance of policies based on an alliance with multilateral bodies. The other law is from 2000, the 'Law of Innovation', which created GATTEC and a new institutional framework. Today perhaps it would be good to have a new law of innovation, but the political process still does not require it. But we are working on this, focusing on new forms of scientific evaluation, mechanisms for governmental purchases, and public-private coordination*".

LEGAL FRAMEWORK OF THE ARGENTINIAN NATIONAL INNOVATION SYSTEM. MAIN LAWS AND ORDERS.

1. Law 25.030 (1996) of Intellectual Property
2. Law 25.457 (2002) Institutional Structure of the National Science and Technology System
3. Law 25.922 (2004) for the Promotion of the Software Industry
4. Order 380 (2005) for the Creation of the Argentinian Nanotechnology Foundation
5. Law 26.270 (2007) for the development of modern biotechnologies.

In the following, we point out the most important differences in the institutional architecture of the National Innovation Systems in the three countries:

1. The configuration of the Brazilian NIS seeks to integrate, into knowledge governance, the education (public and private universities), research, and innovation financing systems, as much through BNDES as FINEP and the Sector Funds managed by the Ministry of Science, Technology, and Innovation. As such, the financing of science, technology, and innovation activities is, explicitly and from the perspective of the legal framework, an integral and distinctive part of the Brazilian institutional architecture, which does not occur in the Argentine and Chinese cases. In the Chinese case, financing does not show up explicitly in the organizational charts of the innovation system, which does not appear to lead to deadlocks in the financing of innovation. In reality, the proximity of the governmental agencies with companies, in the national, sectorial, and regional planes, and according to field interviews, appear to guarantee adequate financing to companies in China, once these have been evaluated positively in terms of their (effective) contribution to technological and industrial development in China. This is, without a doubt, a difference to be emphasized.

To this end, in the Argentinian case, the Minister of Science, Technology, and Productive Innovation, Lino Barañao, stated: "*The Innovative Argentina Plan 2020 is based on three pillars. First, an improvement effort that seeks to reconstitute the national technological system. The goal is to give it coherence so that is a system and not composed of stagnant compartments and, at the same time, coordinate this system with the productive apparatus. In this case it is*

Executive Committees and Sector Competitiveness Councils, the old forums of competitiveness. The members of the Competitiveness Councils will be appointed by the Production Development Office of the MDIC, in partnership with the private sector. The group will be responsible for unrolling objectives and strategic outlook of the GBP in the respective value chains of the sectors. The Brazilian Agency for Industrial Development (ABDI) will be responsible for administrative support to the Executive Commitee, the Executive Office and the CNDI". http://www.brasilmaior.mdic.gov.br/noticias/1017

worth noting a new important tool, which is the 'associative tool' that seeks to create public-private partnerships in the financing of innovation and with requirements for business plans and commercialization". What is being said here, as we observe and confirm later on, I that Argentina **does not** have a proper system of financing integrated into the NIS's institutional architecture.

According to Horácio Cao of the Ortega y Gasset University Research Institute: "*The main limitations that we face in terms of technological policies is, in the first place, the volume of capital needed to finance projects, and secondly, human resources problems, which there are not enough of. In other words, even if I had the money, I would not in many cases have the human resources needed to move the project forward"*.

"The problem is how to identify opportunities and from there generate and formulate projects. There are opportunities, ***but there is a lack of capacity to undertake*** *them; the Science and Technology plan was formulated to solve this, and for this the tool of public-private partnerships was created. There is also a lack of human resources trained in the management of innovation projects. And also certain points of gridlock exist with financial resources and how to formulate better and more complex projects, and how to execute them. Finally, there are problems of intra-governmental coordination and collaboration, there are tools not fully used, for example, government purchasing is not geared towards productive innovation" (…) "The relationship with multilateral bodies have been important in the area of Science and Technology, because in spite of the back and forth they allowed agency financing to continue over the course of time"*. Fernando Peirano – Secretary of Science, Technology, and Productive Innovation Policy (emphasis added).

"Subsequently, the third point of the plan refers to financing tools, which tend to be more and more focused. Sector Funds exist, created recently. These funds are different from the ones in Brazil, which were negotiated during the privatizations and are based on company contributions. In the Argentinian case, these funds are financed by multilateral investment funds (IBD for the sectors and the World Bank for general purpose technologies). In turn, partnership tools were created between the public and private sector. Great quantities of resources are involved (between five and ten million dollars per project), which are implemented through public-private consortiums (universities and companies). This is one of the requirements to participate in the financing. The other requirement is that the result of the project provide a marketable product. The evaluators are international and the projects have an estimated duration of four years. On the other hand, there are financing programs for the university to train 'technology managers' (GETEC) through the FORNARSEC". Ruth Lanheim– Secretary of Planning and Policy of the Ministry of Science, Technology, and Productive Innovation.

To the researchers' question – what could be considered the greatest obstacle to the implementation of decision (bureaucrats, financial resources, socio-economic interests, states' and cities' interests, labor unions, political parties, internal and external controls)? – the National Director for the Ministry of Planning, Marta Aguilar, answered: "*Up to the year 2004 the problem was clearly the* ***lack of financial resources****. Today not as much, but it is still an issue. Another problem is that the bidding process is slow, which complicates implementation. Provincial interests are essential for a project to be viable, it is a logic of negotiation. In turn, financing from multilateral bodies declined over time, they became very desperate after the 1990s. CAF is becoming a leader in recent years, and after the IRSA initiative"*.

China's case could be placed in a very distinct context, as much from the Brazilian case as from the Argentinian case. In our context, it could be said that, despite the existence of a solid legal framework, a well-established institutional framework in terms of financing innovation, available resources and policies that seek to favor financing companies, this financing is not necessarily guaranteed: neither the proximity nor the flexibility needed to serve companies, even less so the intervention in supply and demand by funds for innovation. According to some reports, there are many requirements, legal frameworks, and controls, especially in the Courts of Auditors, but there is a lack of companies truly capable of delivering what they promised. For an explanation of the causes behind these anomalies we will return to this question later on.

In the Argentinian case, based on the accounts of the interviewed policymakers, all of the directors of the highest level, financing still does not appear to be part of the mechanics of the Science, Technology, and Innovation system.

The Chinese case is very representative, as can be seen in the accounts reproduced below.

According to Wang Yuan, of CASTED: ***"****The fifth point is how to implement the twelfth plan, how to carry out these policies, and there are six aspects that are different from those from before. First, we insist in physical investment, which is the tool of direct investment. Meanwhile, we also pay attention to* ***indirect tools, such as fiscal credit and preferential fiscal*** *policies. Until the end of 2012, R&D input in the entire society reached 1.2 trillion yuan, in other words, a little more than thirteen billion dollars. These are direct resources, if we measured indirect resources there would be 100 billion dollars more. The second difference is that we are paying a lot of attention to* ***demand-side policies*** *to promote innovation activities. The third is to* ***emphasize the commercialization and industrialization of research****. Recently, we are leading the institute that works on the Law of Science and Technology in China. We already found a few advances in this policy. The fourth is promoting* ***jobs*** *in the development of policies. The Chinese government revealed many preferential policies for start-ups and small and medium-sized businesses. The fifth is that through* ***new financing tools we want to promote innovation in capital markets****. We provide the financing tools and products to support start-ups from the beginning of research and development until incubation and financing the product. The government created a directing/guiding fund in different Chinese cities, such as Beijing, with the goal of reducing risk in the initial phase, when venture capital enters the company"*. (Emphasis added).

Research Zhang Junfang's account confirms, in a certain sense, Wang Yuan's statements, while being more specific about innovation financing**:** "*I come from the Association for the Promotion of Financing and Investment in Science and Technology. We research financing and investment in Science and Technology. In relation to investment in Science and Technology, in China since the last century,* ***since 1985, our government has tried to link Science and Technology and finance.*** *In 2007, we built* ***a system of cooperation between the different sectors in Science and Technology and the financing department not only of the central government, but also of local governments.*** *We also have developed policies to support entrepreneurship using finance, especially to support small and medium-sized companies. And in relation to investment in Science and Technology, it includes two departments. The first seeks to improve the physical input and even establish some fiscal policy. The second is about* ***financing to improve venture capital and strengthen the banks and capital markets*** *with the goal of building a capital market in China. You will find that in China this year our financing and investment in Science and Technology will develop very quickly"*. (Emphasis added).

Let us now look at the second point of comparison between the institutional architectures of the National Innovation Systems Brazil – Argentina – China.

The ministries' performance[17], in the Brazilian case and in the field of innovation, occurs through the government research and development agencies, which are basically research institutes and function through the principles of open innovation – integrating the institution's own research groups with universities, in ad hoc fashion, and, eventually, with companies. As examples we can cite: the Ministry of Mines and Energy, through CENPES (Petrobrás) and CEPEL (Eletrobrás); the Ministry of Agriculture, through EMBRAPA, the Ministry of Health, through FIOCRUZ; the Ministry of Defense, through the Air Force Technical Center, Nuclebrás, and the Army Technological Center; and the various institutes belonging to the MDIC's structure – INPI, INMETRO, INT among others – as can be seen in Diagram 1.

The comparison with the Argentinian case, illustrated in Diagram 2, highlights the following differences: the involvement of the Argentine Ministry of Foreign Relations, which does not happen in Brazil's case, through the National Commission on Special Activities and the Argentinian Arctic Institute – in the Brazilian case linked to Defense or Development; and the lower structural complexity in the case of the governmental research and development agencies in Argentina, aside from being newer than their Brazilian counterparts.

China demonstrates a more centralized structure, in which the main ministries that coordinate Research and Activity are basically the MOST (Ministry of Science and Technology) which directs the National Program in Science and Technology, and MOE (Ministry of Education). The other ministries are represented through the Academies of Science, such as the CAS (Chinese Academy of Science) and CASS (Chinese Academy of Social Sciences). The coordinating role of NSFC (National Natural Science Foundation of China) is a key component of knowledge governance in China.

Here it is important to emphasize two important differences between Brazil and China. The science and technology governmental agencies in Brazil, linked to the ministries, possess relative autonomy and are, undeniably, centers of innovation, in various cases functioning at the frontier of knowledge in their respective fields. Notably, EMPRABA and CENPES, to cite just two public research companies, are recognized examples of technological leadership in their fields – low-emissions tropical agriculture and deep-water oil extraction.

In the Chinese case, according to the interviews conducted, MOST's coordinating role through CASTED and CASS, which act also as think tanks, seems to be to **integrate the activity of foresight under the same long-term strategic vision.** What must be emphasized is the greater **coordination** that results, in principle, in a system where knowledge governance and strategic coordination are two sides of the same coin and, for this reason, appear more effective.

The second difference that is worth noting, in the same vein as before, is that the integration of public research companies, government institutes at the federal and state levels, with higher education, with universities and state foundations to support research has been accomplished in an ad hoc manner. This has depended on the initiative of the research institutes, of special programs, and notices that enabled, supposedly, this integration. Two paradigmatic cases that

[17]/ Ministry of Science, Technology, and Innovation; Ministry of Development, Industry, and Foreign Trade; Ministry of Agriculture and Agarian Reform; Ministry of Mines and Energy; Ministry of Health; Ministry of the Army.

can serve as examples are the product consortiums (coffee, sugar cane, soy) coordinated by Embrapa, which include stakeholders such as universities and many other institutions. In the case of the Coffee Consortium, there are more than fifty institutions with distinct goals related to the product. The CENPES-UFRJ program, on the other hand, for financing graduate scholarships (development of human resources for research in oil and gas) and joint research with universities and institutes for the research of deep water exploration, as is the case of the oceanic research program with UFRJ, could be cited as another exemplary case.

In Diagram 1, if one accepts the representation there, the higher education system in the Brazilian case, on the left side of the diagram, does not connect with the right side, where the government research and development agencies are located. Evidently, the autonomy and management of higher education cannot be subordinated to the medium-term plans whose emphasis governments can change according to programmatic government policies and strategies. Actually, CAPES' directorate seeks to mitigate this tendency by releasing notices of interest to ministries and agencies, seeking to direct university research toward more long-term goals.

*"In this way, the question is how to manage the complementariness between the productive and academic systems. To this end it was necessary to create a closed communication channel, which is FONARSEC. This is based on public-private projects in previously selected sectors. There is a rigorous evaluation process, mainly as it relates to the projects' originality and viability. (…) The (third) pillar is the relationship between science and society. In this point we base ourselves in joint actions with the Ministry of Education, and in the creation of a communication agency for science and a television channel (tectv). These initiatives seek to disseminate the role of science in society and encourage innovative behavior among social agents". (*Lino Barañao – Minister of Science, Technology, and Productive Innovation)

Better explaining the relations between the research institutes and agencies, Fernando Peirano tells us, "*An axis of the current policy is to create a new environment for the scientific community. Some key agencies do not depend on our ministry, such as INVAP, INTI, INTA. As such, the ministry focuses on the issue of incentives. On the one hand, for research, there is CONICET, and on the other hand, for production, various funds such as FONTAR, FONSOFT, and FONARSEC. (...) The ministry seeks to give a direction to these two points. The science and technology seeks to align these two executive branches and coordinate them with the rest of the National Innovation System. The institutional channel exists for his, in my office, and that of incentives, through Ruth Landheim. The goal is to create a new context for a productive project that integrates innovation. (...) On this point, there exists a question of private investment, which in Argentina is scarce for research and development. In terms of resources, the equivalent already exists on the public side,* ***what is lacking are the incentives so that the private sector invests in Research and Development*** *(see the plan's chart). FONARSEC was created for this reason, which is based on public-private partnerships and in this way give traction to private expenditures in research and development. However, FONARSEC does not solely try to stimulate private expenditures; the consortiums and partnerships also seek to stimulate new behaviors and forms of company management so that they integrate innovation in their practices. In relation to the partnerships between universities and companies, these must be done based on projects. One point to be highlighted is the creation of YPF Tecnología, based on YPF's nationalization. The idea is the creation of proprietary technologies, just as Petrobras has succeeded in positioning itself in deep-water exploration. However, YPF has great potential in shale oil exploration. Also the strengthening of the UVTs (Technology Linking Units) and the*

Centers for Innovation Management, centers of excellence in medium complexity spread over the territory. A specific inclusive innovation program was also created, seeking to lend legitimacy to the spending in science and development".

According to the Policy Secretary of Science, Technology, and Productive Technology, Fernando Peirano, the need for greater integration in the area of science and technology, especially as it relates to energy, has consciously been sought.

"Our relationship with infrastructure policy is in some cases very important, as in the case of YPF. A very good dialogue exists and the awareness that without science and technology it's not possible to advance. Work is being done in the area of wind energy as well, which Argentina has very good resources, but it needs be done from the ground up, from a map of wind potential up to the mechanical technology. A joint effort exists as it relates to dimension of competitiveness: transportation, energy, and logistics. Finally, an initiative is being implemented which is the creation of a research institute on science and technology policy, under the ministry and partnered to Mariano Laplane's CGE".

2. The last question, no less important and, actually, that most converges with the research project's main goal as it relates to comparing the institutional architectures of the respective national innovation systems, is that of **coordination of decisions relating to innovation policy.** The diagrams and, especially, the interviews conducted are the main basis for the analysis below. This material is of great relevance to understanding what is more, or less, effective in directing science, technology, and innovation policy. And how this direction reflects and is conditioned by state capacities for formulating and implementing strategies for institutional change and innovation. In this sense, it is possible through greater or less coordination of strategic decisions to clarify the comparative state capacities in the formulation and implementation of innovation policy, as well as note the comparative institutional advantages that each country built. A propos of this last question, some specificities of each country must be noted.

3.1. First, one must consider the governance and coordination structure of the **Greater Brazil Plan**, in which the Ministry of Science, Technology, and Innovation exercises the "level of management and deliberation". In the Brazilian case, Diagram 4 differentiates, first and foremost, the levels of: High-Level Advising, Management and Deliberation, and Formulation. However, and based on the results of the fieldwork, the Systemic Management Boards seem to act more as advising and issuing policy statements, rather than effectively formulating and developing policies. There is a **high degree of autonomy and decision-making at the level of management and deliberation.** This characteristic seems to be shared by the three cases considered. What **distinguishes** them, perhaps, is the **degree of influence in strategic decisions that the advisory rearguard retains.** Coalitions of interest groups and power are relevant to communicating policy statements from the Sectorial Committees and the Boards to the high-level advisors and the CNDI (National Council on Industrial Development), whose administration is the responsibility of the Office of the President of the Republic.

"The CNDI is formed by thirteen ministers, by the president of the National Bank for Social and Economic Development (BNDES) and by fourteen civil society representatives and is tasked with establishing the general strategic outlook and subsidizing the activities of the management system. Competitiveness Councils – the executive committee is the body that will accompany and supervise the establishment of the Greater Brazil Plan, while the Executive Office will

handle administration. The two will be under the MDIC's direction. Among the Executive Office's functions are the creation of Executive Committees and Sector Competitiveness Councils, the old forums of competitiveness. The members of the Competitiveness Councils will be appointed by the Production Development Office of the MDIC, in partnership with the private sector. The group will be responsible for unrolling objectives and strategic outlook of the GBP in the respective value chains of the sectors. The Brazilian Agency for Industrial Development (ABDI) will be responsible for administrative support to the Executive Commitee, the Executive Office and the CNDI".[18]

In terms of a vision of the future embedded in the Greater Brazil Plan, and according to the Secretary of Science and Technology, who performs the role of coordinating decision-making processes, "what is intended is an integration between industrial policy starting from the axes of the more dynamic chains. What is behind this and what motivated us were the short-term bottlenecks. The long-term vision always permeated".

"We had four points as tenets for decision-making and action. In the first place, the complex productive diversity is not capable of resolving competitive capacity. The permanent investment in capital does not have a counterpart in human resources. There is a clear ***deficit in human resources****. The industrial structure does not induce a significant development of human resources. The increase in investment implicates the formation of fixed capital that renews itself, but which has quick obsolescence. In reality, there is a rapid loss: updating machines and equipment without technology capacity, patents, creating intangible assets, do not generate added value on the frontier".*

"Secondly, the Brazilian economy continues to be specialized in natural resources and with low technological capacity. A portion of equipment and capital goods, as well as microelectronics, is also imported. The introduction of imports does not generate externalities and do not necessarily complete the productive structure. For example, Brazil has the largest herd of cattle in the world, insertion in exports, and also imports. But this does not necessarily create positive externalities, even possibly creating negative ones, and it does complete the productive structure".

"Third, there is great heterogeneity, a duality between the low-tech, low-intensity sectors and the high-tech ones. We don't have enough for the kernel, for the foundation. There is no reasonable technological structure, the workforce is still unqualified and we don't have machines or equipment on the technological frontier. And, finally, our institutional framework is inadequate, doesn't move companies to the frontier, to increase the rate of innovation. We have a still inadequate structure in various governmental agencies".

Returning to Diagram 4, the systemic management boards, sectorial bodies (Executive Committees and Sectorial Competitiveness Councils) would be at the level of coordination and formulation. These dimensions – Foreign Trade, Investment, Innovation, Workforce Development and Training, Sustainable Production, Strengthening Small Businesses, Special Actions in Regional Development and Consumer Well-being – are part of the agenda, but the main policy decisions are in fact made at the level of management and deliberation. In fact, the CNDI, under the Office of the President's direction, is the decision-making body of the Greater Brazil plan, under which industrial, technology, and innovation policy are subsumed.

[18] / http://www.brasilmaior.mdic.gov.br/noticias/1017

In Diagram 5, Governance of the Plan for Innovating Companies, the same observation made above applies. The Executive Committee, formed by the MCTI, MDIC, MF ministries and SMPE (Office of Medium and Small Businesses) is responsible for guidelines, tracking, and evaluation of the plan, and retains the tasks of decision-making and coordination. The implementers of the Plan are the main Brazilian investment and innovation financing institutions – BNDES, FINEP and Parceiros. In other words, once more innovation financing is an integral and fundamental part of the Plan, which does not necessarily assure that the *modus operandi* guarantees agility and flexibility in its implementation. The so-called Innovation Room seems to be the locus of expressing interests from companies as well as business associations, and it is in this body that conflicts of interests are addressed and coalitions developed. In Diagram 4 as well as in Diagram 5, it is not possible to find or visualize the role of the rearguard in scientific and technological production exercised by government research and development agencies, as well as the research institutes, and also the role that private sector research institutes could play. This trait is a blatant contrast with the organizational routines and decision-making processes in the Chinese and Argentine cases, as we will see, and this seems to be the main difference that constitutes, in the Chinese case, an undeniable comparative institutional advantage,[19] namely, **possessing a research rearguard rooted in strategic decision-making processes**.

The Secretary of the Ministry of Science, Technology, and Innovation (before the most recent ministerial change) describes the decision-making and coordination process of the different power-holding bodies in the formulation of innovation policy like this.

"The decision-making process occurs in the bureaucratic stratum. However, the bureaucratic structure was not modernized at the speed the country required. There are still bureaucratic conflicts as a whole. This would require greater training, greater definition of flows and routines, less handling time in legal proceedings, optimization and capacity to respond to society. The inter-bureaucratic conflict exists, in large part, to tackle modernization. The Chief of Staff's Office is the final arbiter, coordinates with the Presidency and decides the target, examines measures and expenses. The negotiation process and resolution of conflicts does not only pass through the Ministry, but is looked at by the Ministry of Finance".

"There was a movement toward organizing a council that had not been formally nominated, and later was formalized. In the beginning, the council was made up of the President and the directors of BNDES, FINEP, the Ministry of Science, Technology, and Innovation, by the Executive Office, EMBRABA, Defense, MIDIC, and the Ministry of Communication.

"This Executive Committee of the Greater Brazil Plan meets with the frequency of every two to three months to evaluate policies and chart future proposals, seeking to embrace all the ministerial strategies. In the case of innovation, the Systemic Committee on Innovation charts policy based on the conclusions of the sectorial committees, consolidating what they say with respect to innovation and making the required adjustments. The Executive Office is a conflict resolution body: it convenes the Secretaries every month, every fifteen days. The Chief of Staff's Office is the body for development and dialogue, which takes place in the Chief of Staff's office itself, the Ministry of Science, Technology, and Innovation, the MIDIC and BNDES. The CGEE and ABDI also are part of the Executive Administration of the Greater Brazil Plan. The

[19] / The concept is discussed by Coriat, B. and Weinstein, O. *in* Organizations, Firms and Institutions in the Generation of Innovation. Re**search Policy 31 (2002) 273-290.**

implementers are BNDES, FINEP, MCTI, and MDIC. The Ministry of Finance convenes and discusses the government's proposal. The governance of FNDCT is more complex, as it relates to resources, scholarships, policy development, decisions are taken in this range. The FNDCT's governance chart shows this".

Let us examine how the main Argentinian directors evaluate the issue of governance and strategic choices. Horácio Cao, from the Institute Ortega y Gasset, observes the following on the question of how to describe the role of government agencies in innovation policy development:

"The main policies begin in the President's Office and are drawn up by a very small group, but they are powerful and become implemented through the relevant agencies. The other policies are developed at the agency level, but are less powerful. I would say that only some policies, rarely, are developed in agencies".

Fabián Repetto, Director of the Social Protection Program (CIPPEC) adds to this perception.

"*The vast majority of public policies currently are developed within the state. The great developer of policies is the President's Office. Sometimes, the various government agencies end up learning through the media of policies being announced for the area (such is the case with AUH and nationalization of AFJPs). This model of top-down decision-making means low capture of expert knowledge, careful decision-making, and little expert consideration. The bureaucracies are rarely consulted. This happens at least in the vast majority of areas, which leaves little space for expert teams. The Chief of Staff has a very reduced role. All of this creates problems in the systemic coherence of public policies, reviving Guy Peters' notion of 'government coherence'. These are fitful measures that tend toward regenerating the State, but poorly articulated. The national government has a great state capacity to perceive the political 'windows of opportunity' (Kingsdom) of a given moment. The decision is made in the moment, but with little planning".*

"There is a dimension of political experience that allows the exercise of state capacity to undertake important measures, but that incorporate little technical capacity, planning, and coordination. But there are islands of technical capacity in this process, and a good example is ANSES. Such islands were very useful for implementing policy measures made quickly, such as the case of AUH. When the Presidency has an interest, the obstacles are overcome in the short-term. The decisions that are considered to be priorities are not delegated to bad expert teams (AUH was implemented through ANSES and not the Ministry of Social Development). But in the medium to long range, there are serious problems whether financial (AUH) or for lack of convergence with the provinces. There is an emphasis on the policy's decision-making moment and not on implementation".

Secretary Ruth Lanheim (Office of Planning and Policy of the Ministry of Science, Technology, and Productive Innovation) on the question of a vision of the future contained in the development of general and specific policy goals for science, technology, and innovation told us:

"The plan 'Innovative Argentina 2020' becomes part of the presidential perspective of trying to link knowledge production with productive development. So one of the first measures the President took was to create the Ministry of Science, Technology, and Productive Innovation in 2008, which before was an office under the Ministry of Education".

The point is relevant, since the Ministry's creation in comparison with the other two case studies, Brazil and China, is late. But what we wish to highlight are the differences between linking knowledge produced about innovation and foresight with strategic decision-making.

The Chinese case has specificities that allow greater understanding of building comparative institutional advantages. Let us look at the important account by Gao Yi, from CASTED. It is important to point out that the architecture of the Chinese innovation system that Yi describes inverts, or better yet, subverts the structure that has been described until now, and which characterizes the Brazilian and Argentinian systems. **The technological innovation that emerges from the real economic system is at the top of the innovation system and not at its base.** Private and public research is not the finishing line but the starting point. The system's second layer is the advisory apparatus for strategic decisions, performed by research institutes, think thanks, universities, and so forth. We see how the Chinese innovation system is described, but it is important to note that his description is the result of consensus, a collective process of creating this structural consensus.[20]

Gao Yi: "I will introduce the basic facts of China's National Innovation System. The Chinese National Innovation System is based on the allocation and distribution of science and technology resources and consists of five parts. The first is the technological innovation system, ***the Chinese Government supports the principle that companies must play a leading (greater) role in innovation activities and also that the market must guide innovation, integrating universities and research institutes.*** *This consists of innovative companies and technological innovation consortiums, and also of innovation and technology platforms. The* ***second part*** *is the knowledge innovation system led by the* ***Universities and Academies, such as the Chinese Academy of Science (CAS)****. The* ***third part*** *is the* ***National Defense System****, based on civil and military use, and focused on development, sharing, and use, and in the dual use of technology for civil and military ends. The* ***fourth part*** *is the regional innovation system based in different* ***regions*** *and their different needs for social and economic development. In these cases, there are differentiated science and technology resources. For example, the eastern region is very different from the western region, and so the regional innovation systems are quite different. The* ***fifth*** *is the agency of science services, such as, for example, the science and technology parks, investment centers, and incubators.* ***The goal is to commercialize and industrialize the results of research and put them in the market.*** *These are, basically, the five parts of the National Innovation System in China".*

This important view of the system can be complemented with Wang Yuan's account.

"For example, MOST has a regular consulting mechanism with the provincial governments and other ministries. Its goal is to resolve problems faced by local governments and help them solve these problems. And this type of mechanism also exists between the central government's different departments. For example, ***MOST as coordination mechanisms with China's banking system to guide them and pay attention to financial activities to promote innovation.*** *The third is the coordination at the level of public policy. For example, policies related with investment, import, and export industries, these policies are developed by different departments and, therefore, must be coordinated to achieve shared goals. This is not necessarily directed by the prime minister or high-level government servants, but simply by the different departments at*

[20] / See also Angang, H. Collective Presidency in China. Institute for Contemporary China Studies, Tsinghua University, June 2003.

*the same level in a **natural and routine way**".*

We are emphasizing the relationship between research, think tanks, and strategic development, as this seems to be an innovation that differentiates China from Brazil and Argentina. To this end, Mu Rongping affirms what follows below.

*"I think it is not easy to bring together the two parts, research and think tank. In the period before the last ten years we made some progress in this sense. This depends on the **degree of influence that you have over the process of public policy**, which is a very important criterion. We have worked for the NDRC for more than twenty years. So, in the beginning one part of our personnel did not occupy positions in the government, but now some of us are already principals. This is because we have a tradition, we get to know each other generation by generation, trust and being a trustworthy person is very important".*

*"As you (the interviewers) mentioned, the five-year plans are a great process of policy development. Every five years, in turn, you need to review the previous five-year plan, and to build the five-year plan it is necessary to perform mid-term evaluations, to evaluate the impact of the plan as you go along. This is done by the key-departments nowadays. But at another time in my experience, the administration ten years ago, when the State Council decided to make some announcements for science and technology, all the ministries or almost all the ministries were involved in the final decision-making process. **Nowadays, on the government's part, we also have many meetings to be able to hear opinions and recommendations from companies, universities, research institutes, and the public**. People can send their opinions on our on-line site. This is not only in general. The development of individual policy projects also relies on these mechanisms. For example, about nine years ago, when we developed the fiscal credit policy for research and development, I had several meetings as well, going for the first time to companies and asking what were their challenges, problems, and their needs. **You have regular contact with companies, businesspeople, and other interested parties. This is a very important part of the decision-making process**".*

*"And also in the plan's large projects, such as the **Strategic Emerging Industries**. I am also the main editor of the two public policy documents relating to developing Strategic Emerging Industries. So, we have had various opportunities to meet with local government and businesspeople through a consulting process. It took two years to do it, from the beginning until the end when the plan was developed, maybe more than two years".*

We emphasize, once more, that this process that Angang termed **"Collective Presidency"** constitutes a relevant characteristic of the strategic decision-making process, as it relates to industrial policy and science, technology, and innovation policy.[21] The relevant question is to know how these processes were institutionalized.

A propos of the issue of the institutionalization or lack of it of advisory process, interviewee **Mu Rongping** adds. *"It is a tradition. For example, now we are conducting strategic studies for the*

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[21] / *In* "Framework for an analysis of collective presidency", Angang asks: "There are also basic questions that concern the decision-making process. Where can we obtain information about decision making? Who makes the decisions? What methods or mechanisms should a decision maker use?"
The two perspectives that inform the so-called collective presidency are information and the structure of knowledge in collective leadership. "Therefore is necessary for them to engage in frequent and full exchange of information to greatly reduce the asymmetry regarding information and knowledge and the accompanying uncertainty". Angang, H., ob. cit., pg. 11.

development of science and technology and the Strategic Emerging Industries for the next five years. I will have finished the baseline report by the end of the year. So in the next year we will try to elaborate the structure of the Five-year Plan for Social and Economic Development, one of the most important five-year plans. And in this five-year plan we will focus specifically in the development of Strategic Emerging Industries and innovation, science, and technology capacities, all of this at the specific level. ***Hence, the Five-year Plan is not only at the central government level, but also in the research organizations, as well as our institute.*** *I think it is very important to think about the future and make plans to achieve select objectives".*

Mu Rongping's account is completed by Wang Yuan. *"I will try to summarize what my colleagues have already said. China's Twelfth Five-Year Development Plan has attracted a lot of attention and interest from many of our colleagues around the world. Indeed, it has a special role in China and is related to the National Mid- to Long-Term Science and Technology Development Plan and was published in 2006. The full version of the Twelfth Five-year Plan can be found on our site, and so I would like to summarize a few main parts of it. First, the end, the purpose. Our development goals until 2015 have two aspects, one is overarching, the other is specific.* ***The global indicator has two aspects: the first is that we are identifying the mechanisms for innovation activities in more than forty countries. And we are also identifying national innovation indicators.*** *In 2012, China is number twenty in the complete ranking of the forty countries. We hope that by 2015 China can overtake one or two countries and become eighteen. The second overarching indicator is science and technology's contribution to social and economic development. This evaluation is exclusive to China and seeks to evaluate the role of science and technology. In terms of the specific goals, there are twelve and we can find them in the official plan, so I will not go into details. However, there are two important requirements the government mentions in this document. The first is to highlight the contribution of science, technology, and innovation to social and economic development, and on the other hand, the stress that the government must perform in the ongoing monitoring and evaluation of this type of policy".*

"The second characteristic I'd like to mention is the way of organizing policy implementation. In 2011, China occupies second in industrial output in the world. GDP per capita in China is still relatively low; in 2012, this number is around $6400 per capita. In China, because of regional differences, there are many provinces with high GDP, with a high GDP per capita. Because of this, it is difficult for China to maintain its economy like before. Accordingly, the twelfth five-year plan issued some new suggestions. First of all, the creation of significant specific funds for science and technology projects. For example, these projects include the ***manufacturing of large planes, nuclear energy reactors, and all integrated equipment,*** *so that total investment in these projects reached $100 million RMB. Secondly, there is the general setup for the new Strategic Emerging Industries. These* ***emerging industries include new materials, electronics vehicles, and environmental protection industries.*** *Let me give an example: in the highly competitive cellphone market, total sales in the Chinese market by domestic companies such as Huawei, Lenovo, Xiami outpace that of Samsung and even the iPhone. The iPhone occupies maybe the fifth position in China's market. Another example is* ***LED lighting****, which has already become the main source of public lighting in China's main cities. The third is to improve the innovation capacity of traditional industries. It does not matter how much we are able to strengthen and improve the high-tech environmental industries since its participation in the total GDP will never be more than 20%. As such,* ***one direction for the development of traditional industries is to achieve green manufacturing.*** *The fourth is to*

pay more attention than before to basic research. In the past and still today, China is an emerging economy that must catch up with other countries. Innovation capacity is still not enough. Accordingly, in the last few years, the Chinese government has paid great attention to basic research and growing investment for basic research, which in fact is growing rapidly. The fifth is ***to focus great attention on people's quality of life****. For example, in the area of* ***water resources, medical services, health, distance learning****, seriously emphasize this aspect. Therefore, our concern is how to conduct and propel science and technology development to satisfy social and economic needs and achieve sustainable development".*

"The third aspect is the transformation of the innovation system. As Dr. Yi mentioned, the transformation of the National Innovation System is based on four points. First, the ***company must perform the main role in the market.*** *Secondly, the* ***coordination of innovation between different regions and agencies.*** *Third, the most important point, under the central government's general guiding principal, we pay great attention to local practices and developments, in the local governments. The fourth point is how to transfer the role of government and how to achieve institutional reform inside the government agencies".*

"The ***fourth aspect of the twelfth plan is about talent.*** *Just as you mentioned in relation to the collaboration with Tsinghua University and other research institutes, maybe you can observe and discover that there are a great many experts and professionals returning from abroad. At this moment there are many experts abroad willing to return to China to start their own businesses. Actually, on this point,* ***we already have started to study and work on the thirteenth five-year plan.*** *It is a pleasure for us to provide some help and assistance in your research and we are willing to welcome you into our projects, such as the project on sustainable development in the BRICs".*

Asked about the actual role played by CASTED in decision-making process, whether the institution had a basically advisory role, Wang Yang clarifies in the following.

"CASTED serves mainly as a ***think tank for MOST****, supplying policy consulting and support. And also as in the twelfth plan, CASTED has participated in almost all of the stages from beginning to end, from the preparation work to the final development.* ***This has already become a systemic working mechanism.*** *This is related with CASTED's role. It has a broad role and research capacity to perform this type of work. In CASTED, we have eight different research institutes to perform this task".*

It is important to clarify, in terms of the criteria used to choose technological research areas that are being, and will continue to be, emphasized, how strategic emerging industries are selected. The research began from the hypothesis that technological choices had as a goal **to reach the technical frontier defined by the United States**, and in this sense **the predominant goal would be technological build-up, or catching up.** However, the concept of "endogenous innovation" contrasts with the notion of a process mirrored from the outside. Accordingly, the question is whether the concept of endogenous innovation is a technological or an economic concept? On a smaller scale, one could ask about the existence of national standards, or if the idea of endogenous innovation is used as a policy tool. On the other hand, the three-sided dialogue between China, Japan, and Korea suggests interrogating how this collaboration occurs, having as a reference point the definition of the frontier among these countries.

Dr. Wang Yuan addressed these complex issues. *"For the first question, about the selection criteria for industries, we have an evaluation and monitoring mechanism for the main industries*

around the world, in terms of their development trajectories and tendencies. The second reference point is based on our domestic conditions, in other words, China's social and economic needs for future development. So, if we compare the twelfth plan with previous ones, there is a difference in the choice of industries. This is because we are dealing with a different era, we have different concerns, and the issues in society also have changed. In terms of the hypothesis that was raised, ***we are in fact working with foresights****, supported by the* ***opinions of thousands of experts, scientists, and engineers****. In this process, we can guess which industries will develop faster in the future and which industries will have a greater impact on social and economic development in the future".*

In terms of CASTED's role in the organization and operation of Dialogues on Innovation, the same interviewee explains. *"First, CASTED has participated in activities under the aegis of Dialogues on Innovation China-USA. This includes not only government activities, but also non-governmental mechanisms for academic research have already been establish, led by CASTED. Secondly, China propels the Innovation Policy Platform with Germany. MOST's minister lived in Germany for more than a decade, so he has a deep connection with that country, since he also studied there. Third, there is the International Research and Training Center for Science and Technology Strategy. Just yesterday we had the opening ceremony for the second training program, which is a good platform for international cooperation for South-South collaboration. Fourth, with the International Collaboration Department of MOST, CASTED has a China-OCDE dialogue on technology and innovation. Fifth is the triple platform China – Japan – Korea, an additional forum for science and technology. And so, these are the five platforms and the basic mechanisms for international cooperation here at CASTED".*

"Now, I would like to speak a little more about the Twelfth Five-year plan with my colleagues. I would like first to present the basic structure for policy development in China for the five-year plan. Since the eighth five-year plan in 1995, when the government developed and published the plan, it was a comprehensive development plan in its social and economic aspects. And under this broad framework, the government issued some specific development plans for various sectors. Among these specific development plans, two of them have to be approved by the State Council: one is the science and technology plan and the other is the education plan. Not only approved, but also developed by the State Council. The other sectorial development plans are developed at the department and agency level, only these two development plans I mentioned are conceived, issues, and developed at the State Council, at the national level. And so, after defining the development plan at the national level, at the local and provincial level, local governments later also develop their own development plans according to their own conditions. In this development process they identify some projects and focus on some specific targets".

China possesses, or seems to possess, an undeniable institutional comparative advantage in terms of decision-making processes for science, technology, and innovation policy: building consensus based on a long advisory process that begins with companies, considers research institutes and universities especially in terms of technological foresight, and responds to local and regional needs. We repeat here that it seems to be an important key to understanding the differences between Argentina, Brazil, and China. The architecture of the Chinese innovation system inverts, or better yet, subverts the structure that has been described heretofore, and which characterizes the Brazilian and Argentinian system. The technological innovation that emerges from the real economic system is at the top of the innovation system and not at its base. Private and public research is not the finishing line but the starting point. The system's second

layer is the advisory apparatus for strategic decisions, performed by research institutes, think thanks, universities, and so forth. The Chinese innovation system seems in fact to be the result of consensus, a collective process of creating this structural consensus.

THE CHINESE CASE: STRATEGIC EMERGING INDUSTRIES [22]

The State Council of China published in 2010 a document titled "Decision of the State Council on Accelerating the Cultivation and Development of Strategic Emerging Industries" (Guofa, 2010 No. 32), in which seven specific industrial sectors were identified that should consolidate technological development in China in the following years. The document establishes a quantitative target for the growth of Strategic Emerging Industries, which should represent 8% of GDP in 2015 and 15% in 2020.

Later on the "12th Five-Year Plan for National Strategic Emerging Industries" (Guofa, 2012, No. 28) was published, which establishes specific targets for development for the Twelfth Five-Year Plan and various public policy measures to facilitate development in these industries.

This initiative, along with sixteen mega-projects presented in the Medium and Long Term Program of Science and Technology, corresponds to a phenomenon defined by Naughton and Chen (2013) as "The emergence of Chinese techno-industrial policy". According to them, the main characteristics of this new policy model are:

- A significant increase in budgetary and other resources to support investment directly in high-tech sectors;
- Direct policies that designate specific sectors, companies, and technologies for support;
- Multiple and overlapping policy tools geared toward providing additional incentives or protection to specific sectors or companies, with the goal of increasing the impact of direct policies.

To push this initiative forward, the government chose seven sectors and thirty-five subsectors that guide the priorities for resource allocation. According to the interviews conducted in Beijing, these sectors were chosen based on various studies about the growth potential of these markets at the global level in the next years. The environmental question was also mentioned as strongly influencing the choice; China at the moment faces serious ecological problems that range from pollution to the scarcity of important natural resources.

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[22] / The data sources for this section are: State Council of China -- Decision of the State Council on Accelerating the Cultivation and Development of Strategic Emerging Industries (Guofa, 2012 No.32); State Council of China - 12th Five-Year Plan for National Strategic Emerging Industries (Guofa, 2012 No.28); Sylvia Schwaag, Serger& Magnus Breidne - China's Fifteen-Year Plan for Science and Technology: An Assessment. Asia Policy, Number 4, 2007; Barry Naughton and Cheng Lin - The Emergence of Chinese Techno-Industrial Policy, 2013, US-China Business Council – China´s Strategic Emerging Industries: Policy, Implementation, Challenges, & Recommendations, 2013.

Sectors and subsectors – Strategic Emerging Industries

Sectors	Subsectors
New Information Technologies	New mobile communication, next generation internet, triple-play networks, internet of things, clouding computing, integrated circuits, new displays, high-end software, high-end servers, and information services
Efficiency energy and environmental protection	High-efficiency power and energy savings, advanced environmental protection, products and services for recycling of resources
Biotechnology	Biomedical industry, biomedical engineering products, bio-agriculture, and bio-manufacturing
High-end manufacturing	Aircraft equipment, satellites and their uses, equipment for railroads, intelligent manufacturing equipment
New energies	New nuclear power production, solar-thermal power use, solar and thermal photovoltaic power, wind power equipment, smart grid, biomass power
New materials	New functional materials, advanced structural materials, high-yield fibers and their components and basic materials

Source: State Council of the People's Republic of China

One of the aspects that distinguish the Chinese system of government is the fact that it regularly produces a programmatic document on official policy. The five-year plan contains guidelines that orient generic operations and the main thrusts of public policy. However, these plans are always operationalized with a set of specific policies for each of the goals. The case of strategic emerging industries does not differ from this methodology, beside the

The case of strategic emerging industries does not differ from this methodology. Aside from the selection of sectors, specific capacities were established for the Chinese national innovation system's main bodies. In the table below, the institutions of the central government involved are and their main responsibilities described.

Governance structure – Strategic Emerging Industries (SEI)

Central agencies	**Local and provincial agencies**	**Responsibilities**
National Development and Reform Commission (NDRC)	NDRC local offices called Development and Reform Commissions	• Leads coordination of SEI among central government agencies • Guides general SEI

		policy development • Formulates main documents on SEI policy as well as catalogues of main SEI products and services
Ministry of Industry and Information Technology (MIIT)	Local MIIT offices called Economy and Information Technology Commissions	• Plays an important role in developing specific plans for 4 out of 7 SEI sectors: advanced manufacturing equipment, new materials, next-generation information technology, and efficient energy technology • Participates in developing SEIU policy within the intra-governmental process and also develops its own SEI catalogues

Ministry of Commerce (MOFCOM)	Local MOFCOM offices are called Commerce Commissions or Departments of Commerce	• Coordinates SEIU policy development and implementation with other agencies
Ministry of Science and Technology (MOST)	Local MOST offices are called Science and Technology Offices	• Coordinates SEIU policy development with other agencies with particular emphasis on propelling national innovation and technology capacity • Basis support for SEI R&D

		• Administers science and technology funds and national programs
Ministry of Finance (MOF)	Local MOF offices are called Departments of Finance	• Functions as main administrative agency for funds geared toward SEI development
State Intellectual Property Agency	Local SIPO offices are called Departments of Intellectual Property	• Focuses on protecting SEI's IP rights • Coordinates with other agencies for IP rights protection in SEI policy

Source: State Council of the People's Republic of China

In turn, policy guidelines define a set of goals and targets to be reached in a certain amount of time. In general terms, as was mentioned earlier, the sector defined by the policy of Strategic Emerging Industries should represent 8% of the GDP in 2015 and 15% in 2020. However, there are also goals defined for each sector and subsector. Below, the main targets for each sector are presented.

New Information Technologies:

- Accelerate building vast, integrated, and safe information networkers, promote R&D and production of a new generation of mobile communication devices, as well as key equipment and intelligent terminals for the next generation of the Internet;
- Accelerate convergence for triple-play, promote R&D in the "internet of things", and cloud computing;
- Develop key and basic sectors such as integrated circuits, new display models, high-end software, and software servers;
- 2015: Production of new flat panels to meet 80% of local television demand.
- 2020: Own brand in operating systems and software tools with international influence. Join the international vanguard in e-commerce services.

Energy efficiency and environmental protection

- Research, develop, and promote energy efficient technologies and products to achieve advances and increase general energy efficiency;

- Accelerate broadly applicable technology R&D and production that can be used for recycling resources and industrial re-manufacturing;

- Promote clean coal and salt water use.
- 2015: Solid industrial waste recovery rate of more than 72% and waste recovery rate of 70%.
- 2020: Reach international level in energy consumption per unit of production. Advanced international level in the main equipment and environmental protection technologies.

Biotechnology

- Develop biotech-derived pharmaceuticals, new vaccines, diagnostic reagents, chemical drugs, modern Chinese medicine, and innovative drugs that prevent critical diseases;

- Promote the development of bio-agriculture, including biological reproduction, green agriculture, and biological production;

- 2015: More than 30 intellectual property rights for new drugs and more than 200 dosage forms in the international, *mainstream* market.
- 2020: Master cluster of key medicines. One or two seed companies to enter top of global seed industry, 10-15 agricultural bio-products with international competitive advantage.

High-end manufacturing equipment

- Strengthen and expand the aviation industry, focusing on developing key aviation equipment for central routes and regional flights;

- Promote the construction of aerospace infrastructure to develop satellites and related industries;

- 2015: Produce regional aircraft in mass. Reach international level in automatic control systems and industrial robots.
- 2020: Complete development of new regional airplane. Complete global observation of the Earth, global satellite navigation and positioning and communication..

New energy

- Research and develop a new generation of nuclear power and advanced reactors;

- Accelerate the application of solar power technologies and explore diversified markets for photovoltaic and thermal solar energy production;

- Perfect wind energy technology and equipment, promote the development on a large scale of wind energy, and develop new energy systems;

- Explore the use of biomass energy in accordance with local conditions.

New materials

- Develop new materials such as rare earths, high-yield membranes, special glasses, functional ceramics, and semiconductor lighting materials;
- Develop advanced structural materials, such as high-quality steel, new-mode alloy material, and engineering plastics;
- Develop high-yield fibers and composite materials, such as carbon fibers, aramid fibers, and ultra-high molecular weight polyethylene;
- 2020: Understand state-of-the-art new material technologies. Build an industrial chain and break the foreign monopoly in the materials and high-end products market.

New energy vehicles

- Develop basic advances in battery-powered motors, drive motors, electronic controls, to promote the application and commercialization of plug-in hybrid and pure electric vehicles;
- Research leading and basic technologies for fuel-cell vehicles and vigorously promote low-emissions and energy efficient vehicles;
- 2015: New, higher potency battery for vehicles;
- 2020: New energy vehicles. 300 Wh/kg battery module. Production and total sale of 5 million hybrid vehicles.

As was mentioned in the beginning, one of the characteristics of the new Chinese innovation policy is the use of direct support tools that single out specific sectors, companies, and technologies to be supported, as well as multiple and overlapping policy tools geared toward promoting additional incentives. This relates to the Hu Jintao and Wen Jibao's style of administration, which, to the contrary of various Western analysts' expectations of continued openness and liberalization, has been characterized by a more interventionist tendency, particularly in the economic sphere.

Hu and Wen's administration placed renewed emphasis in active state planning based on medium and long-term social, economic, and technological planning. The changes in the process of developing and implementing processes described by Naughton, the greater control on the part of the central leadership and the new interventionist tendency in the government are related with the ascendancy and arrival to power of a new coalition with a more interventionist and centralizing mindset (Heilmann e Shih, 2013). The effects of the 2008 financial crisis would punctuated this characteristic even more by requiring a plan of economic stimulate growth. It remains to be seen if the new Chinese Communist Party's leadership that rose to power recently will continue to follow this logic.

In the case of Strategic Emerging Industries, a number of direct public policy measures and incentives were established to impel the development of these sectors. Some of the main measures defined in the official plan follow below.

- Preferential policies and industrial development plans for the production of integrated circuits; support for research on integrated circuit components and design and chip production;

- Strict application of the energy evaluation system;
- Greater financial support to improve the energy pricing mechanism;
- Promote environmental taxes;
- Promote reform of resource taxes;
- Improve management and recording of medicines, management of prices, licensing, and buying policy;
- Improve laws and regulations in bioethics;
- Improve intellectual property rights policy in the seed industry, biosecurity, and market;
- Introduction of specific policies to support growth in general aviation;
- Develop policies to incentivize private capital to enter the satellite market;
- Development and application of risk clearing mechanisms;
- Promote joint civil-military projects;
- Improve policy on fiscal incentives to incentivize consumption and use of new energy vehicles;

It should be noted that these public policy measures are complemented by a series of local government incentives. This is a series of specific fiscal and financial incentives for the establishment of these new emerging industries, which are defined in various "Catalogue guides to investment". However, many of those subjects interviewed in Beijing said that these incentives could be counterproductive, insofar as local governments tend to compete to attract these investments by granting elevated benefits to the companies involved. In this way, they run the risk of low efficiency in the allocation of capital, which ignores real market growth perspectives and the capacity for absorption of new products. There have already been cases of excess production in the case of solar energy panels. According to the interviewed experts, the fundamental question for the success of Chinese innovation policy consists in finding the balance between public policy tools and market incentives.

*"In the last 10 years, economic growth in China was so fast that the government directed more and more resources, and it tried to allocate these resources in central areas that they thought were important. But, in turn, natural resources were compromised. Now we want to solve these problems, which means giving more incentives for endogenous innovation, but also more incentives for the consumers of innovation products, the demand side. On the other hand, the government promotes a greater place for the private sector and the reform of state companies. The question is how to combine the State with a market approach, public policy tools, and market incentives". (*Liang Zheng –Tsinghua University)

2) Innovative Argentina 2020

National Science, Technology, and Innovative Production Plan

Strategic Sectors:

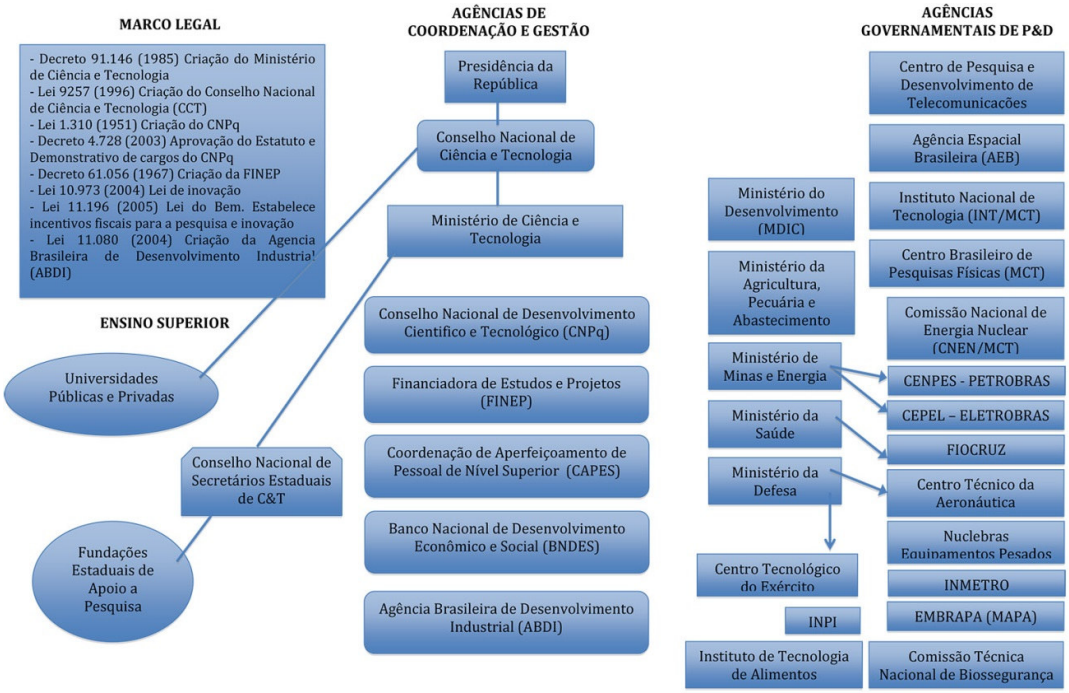
With the objective of intensifying the Argentine development process, the Plan chose a strategic of focusing on areas of science and technology where new opportunities have already emerged and where public policy could generate significant changes. Based on this vision, six large areas were chosen and thirty-four "Strategic socio-productive clusters", to guide the National Innovation System's workload.

The Strategic Socio-productive Clusters combine the use of potentialities that offer general purpose technologies with distinct socio-productive sectors and certain geographical areas, with the goal of generating qualitative gains in productive competitiveness, quality of life among the population, and positioning in terms of emerging technologies and foreseeable technological development in the medium and long ranges.

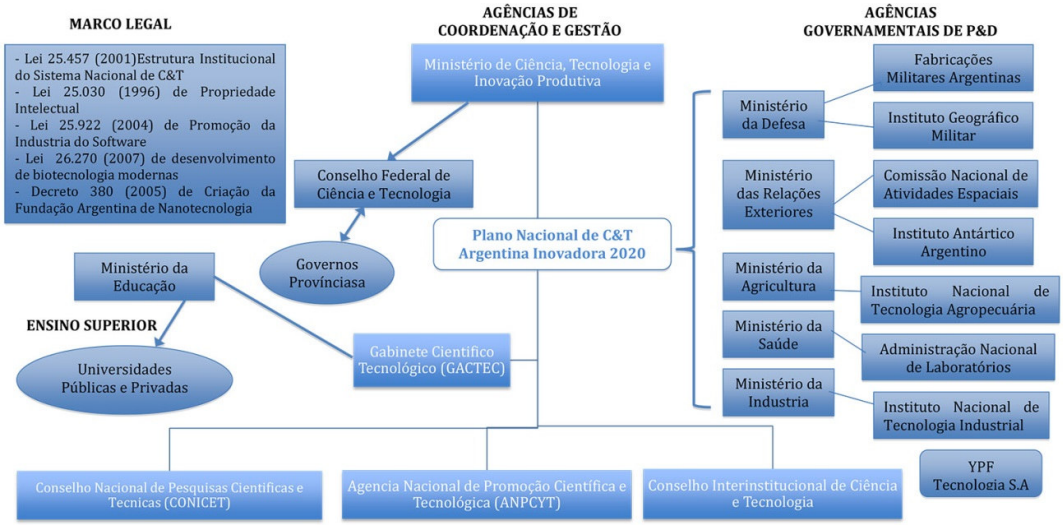
Sectors	Strategic socio-productive clusters
Agroindustry	1. Improvement of crops and seed production 2. Food processing 3. Bio-refineries, chemical compounds 4. Agricultural machinery, processors, and foods 5. Traditional and non-traditional animal production 6. Production and processing of horticultural resources 7. Production and processing of forestry resources 8. Production and processing of oceanic resources
Environment and Sustainable Development	9. Systems for the capture, storage, and dissemination of environmental data 10. Water resources 11. Restoration of degraded resources 12. Reduction of greenhouse gases. 13. Recycling waste 14. Adapting to climate change in urban environments 15. Economic valuation and evaluation of eco-systemic services
Social Development	16. Social economic and local

	development for inclusive development 17. Habitat 18. Technologies for disabilities
Energy	19. Solar power use 20. Electricity generation and distribution – smart grids 21. Alternatives to energy crops and processes for the second-generation production 22. Rational use of energy 23. Technologies for gas and oil
Industry	24. Auto parts 25. Transformation of natural resources into industrial products of high added value 26. Electronic components 27. Medical equipment
Health	28. Biological products (including monoclonal antibodies) 29. Infectious diseases 30. Complex, chronic diseases with multigenic components and associated with adults 31. Bioengineering of tissues and regenerative medicine 32. Phytotherapy 33. Platforms (genomics, GLP, RMN, phytopharmaceuticals) 34. Nano-medicine

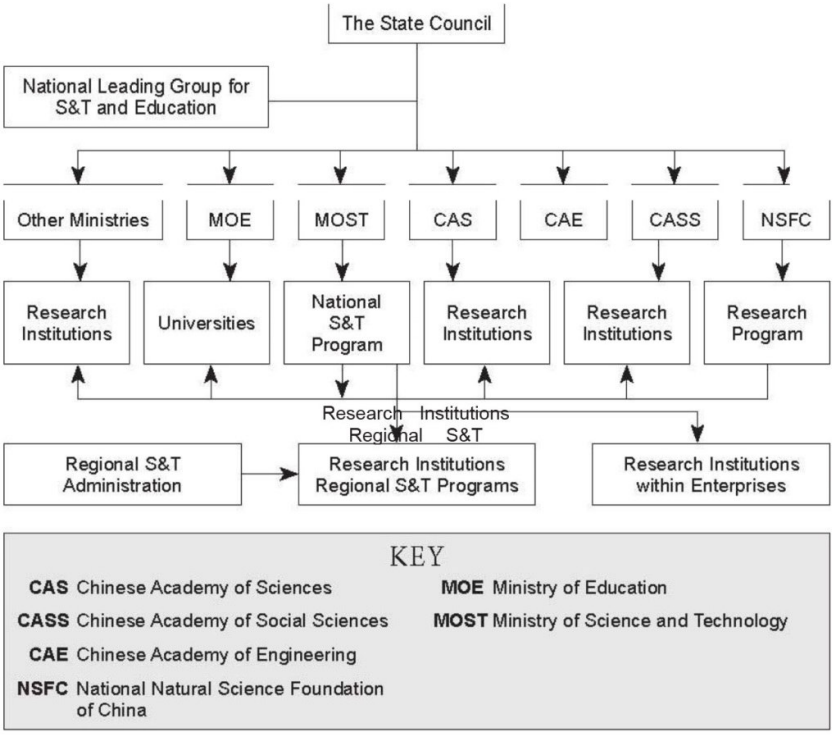
Figura 1: Sistema Nacional de Inovação Brasileiro



Sistema Nacional de Inovação Argentino

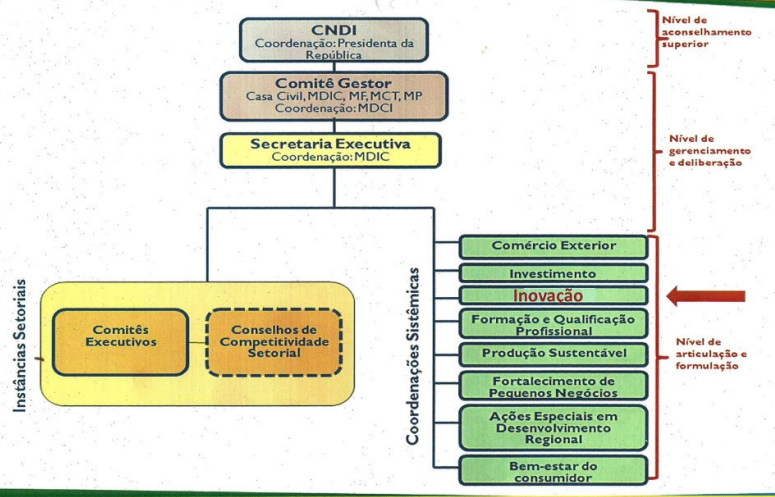


Governance Structure of China's Science and Technology System



Source: Rongping Mu, "Development of Science and Technology Policy in China," 2004 u http://www.nistep.go.jp/IC/ic040913/pdf/30_04ftx.pdf.

Estrutura de Governança



Ministério da
Ciência, Tecnologia e Inovação

GOVERNO FEDERAL
BRASIL
PAÍS RICO É PAÍS SEM POBREZA

Governança

Linhas do FNDCT

FNDCT

Fomento à P,D&I

Mais **importante instrumento de financiamento** para implantação e consolidação institucional da pesquisa e da pós-graduação nas instituições de pesquisa brasileiras e de expansão do sistema de ciência e tecnologia nacional.

Apoia todo o espectro de atividades de **pesquisa científica e de desenvolvimento tecnológico** em todas as **áreas e setores estratégicos**; a formação de recursos humanos e o fortalecimento e consolidação da infraestrutura de ciência e tecnologia nacional

Modalidade: Aplicação de recursos públicos não reembolsáveis em ICTs públicas e privadas sem fins lucrativos.

Subvenção Econômica para a Inovação

A **subvenção econômica à inovação** é um dos principais instrumentos da política de fomento do governo, largamente utilizado em países desenvolvidos para estimular e promover a inovação nas **empresas**

Modalidade: aplicação de recursos públicos não reembolsáveis diretamente em empresas, para compartilhar os custos e os riscos inerentes às atividades de inovação

Instrumentos de Crédito

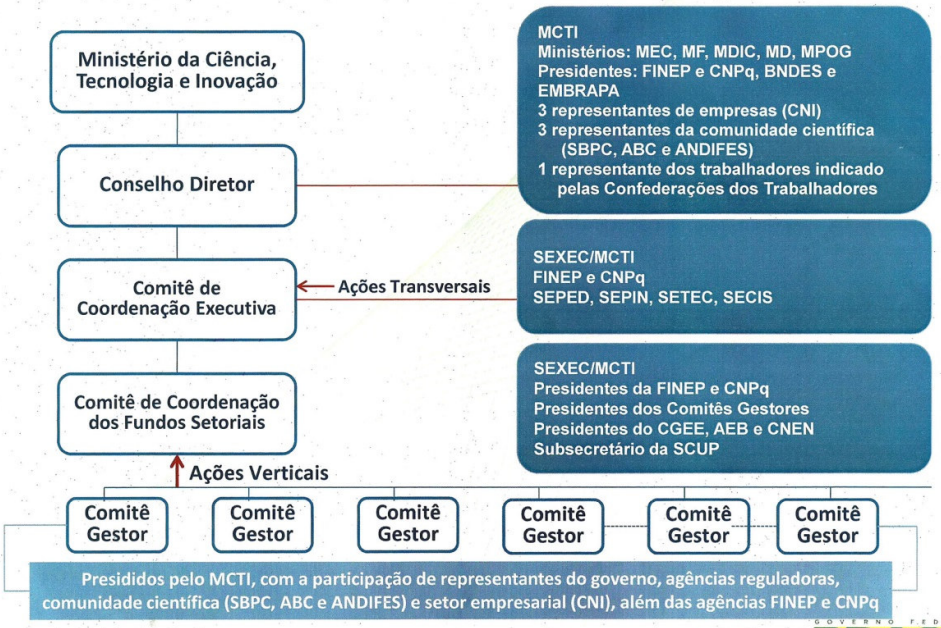
Equalização de juros: Financiamento reembolsável, onde parte da Taxa de Juros de Longo Prazo/TJLP é quitada pelo FNDCT e outra parte pela empresa beneficiada, para fomentar a inovação com juros similares aos praticados no exterior

Capital de risco: Aporte de capital para investimento em projetos de inovação de empresas de qualquer setor e incentiva/estimula fundos de capital de risco

Garantia de liquidez: Mecanismo de operacionalização da reserva técnica destinada à liquidez dos investimentos privados em empresas de base tecnológica

Participação no capital: Participação minoritária no capital de microempresas e de empresas de pequeno porte de base tecnológica

Governança do FNDCT



Ministério da Ciência, Tecnologia e Inovação

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

Consolidação do SNCTI

Ministério da Ciência, Tecnologia e Inovação

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

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