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Innovation and the Development Agenda

By **Glauco Arbix**

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At the starting point of this essay are some of the recent developments implemented in Brazil to structure a more integrated and coherent encouragement of innovation in the economy. Instruments such as the Sector Funds, created in the late 90's and the Law of Goods (Lei de Bem) (Number 11.196/2005) and Innovation Law (Number 10.973/2004), adopted in the wake of the Policy of Industrial Technology and Foreign Trade (PITCE-- 2004) play an important role in building an environment that encourages innovation. In open contrast with the instruments available at the end of the developmentalism cycle, Brazilian companies can have access to (i) innovative tax incentive for R & D similar to that of advanced countries, automatic and with considerable reduction of bureaucratic procedures, (ii) a system of subsidies for projects aimed at technological development, (iii) subsidies to place researchers in companies, (iv) funding programs for innovation venture capital, (v) legal framework more conducive to the interaction between universities and companies.

When compared with the past, progress in the terms of establishing and facilitating links between generation, accumulation of knowledge and innovation is clear and obvious. In terms of the future, there is still a long way to go, either with regard to creating new and improving existing instruments, or laying the roots of corporate culture of innovation by the incorporation by public institutions and universities to conduct systematic search for interactions and synergies with the economic agents. An environment friendly to innovation that a modern economy seeks is marked by the confluence of knowledge, exchange of skills and diversity of sources, public and private. To release an enterprise's potential, the process of planning, while important, only partially accounts for success. Reflection on the innovation agenda, therefore, points to the search for new syntheses between the public and private sectors in Brazil, far from the protectionist "stateism" and market fundamentalism that has so many times marked our history.

This article explores in five sections the following points:

■ the recent changes of the development agenda in Brazil,

■ innovation, basic and company research,

■ new challenges,

■ the transition to an economy based on innovation.

New Directions in Brazil

Traditionally, Brazilian literature on the subject of innovation was strongly associated with technological development, seen as one of the pillars of competitiveness of a country. Only more recently, technological potential began to be considered in relation with companies, their investments and competitive strategies¹.

It is important to remember that after a cycle of industrialization and accelerated growth of almost forty years, Brazil experienced a long period of macroeconomic instability, which significantly influenced the very agenda of government, academia and business. In a certain sense, the macroeconomic debate that characterized the country in the 80's and part of the 90's, required the development of analytical techniques in areas farther from the debate on innovation than many countries. At the same time, the lack of accurate information about the innovative activities in enterprises in this period also limited the research work that might suggest innovation as generator of new dynamics in the economy.

The change of perspective, however, would arrive in 2003 and 2004, with the announcement by the federal government's Policy of Industrial, Technological and Foreign Trade Policy (PITCE), structured around innovation. The emergence of PITCE stressed the need for rapid advancements in constructing a long-term view on the limits and development of Brazilian industry.

Several studies have contributed² and begin to reveal that the sustainability of Brazilian economic growth in the medium and long term is closely linked to utilization and knowledge generation, as well as the ability to transform knowledge into technological innovation.

It is true that part of the technological innovation of firms in developing countries will be achieved through purchase

of capital goods, often imported from developed countries. However, the generality of this argument may mask real business progress and specific features of the dynamics of technological absorption in Brazil.

Given the characteristics of the Brazilian productive arena and the specific significance that the knowledge-intensive activities have in the economy, research showed that investment in R&D generates increased investment in physical capital and accelerated growth of firms. This is a key issue for countries like ours that want to migrate to more advanced positions of economic and social development.

Several estimates done for Brazil³ revealed that investment in firms' R&D generates a higher investment rate in fixed assets, a clear reversal of the traditional causality. From the standpoint of public policies, to prove this hypothesis is especially important because it signals to governments that the incentive to innovate at enterprises, to invest in R&D, in product differentiation and processes, and in diversification of organizational strategies and business parts are essential pieces in increasing the overall investment in the economy.

Why does investment in innovation and in R&D in companies lead to an increase in physical capital at the firms? What would support this casual relation?

The trajectory, simply, is as follows: (i) firms invest in innovation and generate new products, services and processes for market, (ii) the manufacturing activities, structuring and marketing of goods and services would need to be reordered to bring the entire company to their new strategies and innovations, (iii) the adjustment and restructuring would be possible by new investments in physical capital needed for expansion, organizational changes, new models of assembly and logistics business – not to mention habits and culture, (iv) finally, these new investments act to propel the growth of the company.

This differentiated view of the technological dynamics of Brazilian companies, and particularly the attempt to establish causal relationship between the growth of companies and their innovative strategies, encouraged visions of the heroic lone inventor or innovator, supposedly characterized by his genius.

It is true that invention and innovation are connected by a continuum. In advanced areas, inventions and innovations occur so frequently and quickly that it is not always easy to distinguish from one another, as in nano and biotechnol-

ogy labs. But beyond the laboratories, innovation refers to a first commercialization of an idea or project, therefore, its privileged location is the company, capable of fine-tuning production and marketing. The invention, on the other hand, has a different orientation. It occurs in another sphere, in whatever space – in laboratories, universities, research centers and at the firms.

Certainly there are bridges and links between invention and innovation. What is clear is that understanding the transformation of an invention into innovation does not always happen quickly and requires different types of knowledge, ability, skill and resources. In this sense, the qualities of innovator and the inventor tend to be different, despite all the threads of continuity, through practical and theoretical knowledge, that can link one to another.

In the turbulent process of spread of technologies, virtually all the improvements and enhancements that represent points of inflection in the trajectory of an invention have been implemented even before its full commercialization.⁴ Given its power as a transformer and mobilizer of the economy, this is a process that leaves greater marks on the countries' development.

In a seminal study from the 80's, Kline and Rosenberg explain in the following form the systematization and continuity of this process of innovation:

*The fact is that the majority of the most relevant innovations undergo drastic changes throughout their lives - changes that can completely transform their economic significance. The improvements that an invention receives after reaching the market may be much more significant, from an economic standpoint, than the invention itself in its first form.*⁵

From this perspective, a successful invention is always included in a historical trajectory, without which understanding would be difficult. Each invention always shows in its genetic code a long-term process, responsible for its maturation after (and even before) entry into the marketplace. In this sense, innovation should not be defined by the exact moment of entry into the marketplace.

The central issue, on one hand, is that the major innovations come to the world in very primitive conditions which makes immediate marketing impossible. It is the start of competition between firms, mainly based on small changes, additions, and copies, which allows for the evolution into a viable object for the marketplace. Under these

conditions, the process of innovation is the result of extensive processes of improvement and redesigns, which may involve – or not – technology, basic research or applied research. That is, all processes, discoveries, new products or services – whether high-tech, low-tech or no-tech - that add economic value to the company are understood as innovations. On the other hand, the evolution and convergence of new technologies may lead to a new way of looking at an invention that lies dormant, seemingly with no future. Time, in this case, as a cradle for developing new applications and technical possibilities, is essential.

In Brazil and abroad, the debate about the meaning and potential of innovative practice still suffers from conceptual confusions. Many adherents of the heroic vision closely link invention and innovation processes and see innovative advances related to high technology. As a result, they lose sight of subtle mechanisms, seemingly minor and unimportant, as well as the evolution of other technologies in parallel or different spheres, which may be the real engines of the economy.

It is not easy, however, to visualize the innovative processes in all their breadth. This is not only because it is difficult to project different uses and appropriations of the original plans that users and other companies will make on the object. But also because, in general, innovation goes beyond the horizon of business and develops through an extensive network of employees, and its commercial aspect is only one of its many faces. Thus, the web that innovation forms involves companies, entrepreneurs, researchers, distributors, research institutions and consumers, in a scheme that creates highly diverse and complex ecosystem. It's therefore no wonder that management textbooks, related consultancies and innovation guides, with rare exceptions, are sources for generalities.

In fact, there is no ready recipe for guidance in this environment that, despite research advancements, still resembles a labyrinth. But generally, positive environmental considerations include high quality of human resources, an ongoing flow of ideas and information without preconceptions and, above all, a foundation conducive for entrepreneurship to translate into innovation. This means that innovation always occurs in an environment of uncertainty, which is a source of strength in companies.

The further the knowledge of the entire eco-system of innovation is advanced, the more associated uncertainty and risks can be minimized.

As always, it is not always easy to convince organizations devoted to the short-term to value the learning processes that are a fundamental component of experimentation. Precisely for this reason, institutions and companies that are open to innovation, occupy a prominent place in the dialogue between departments and tolerance for novelty. The constant interaction between technicians, engineers, designers and planners, to facilitate connections and interpersonal and interdepartmental synergies, constitute the most precious raw materials of modern organizations.

The slow road

With this present sense, concern about the innovation and knowledge is new in Brazil, a country more traditionally concerned with support and encouragement of scientific research.

Brazil is a country that industrialized late and also delayed the deployment of a system of S&T. It began a process of strengthening S&T in the 70's, being the first public effort to support the sciences, with the creation of graduate studies with support from CNPq, FINEP and CAPES. This was followed by strengthening of competitive funding mechanisms for scientific research in universities and research institutions (CNPq, FINEP and Foundations for Research Support). In their conception, however, a robust system for financing and encouraging technological development and innovation in enterprises was lacking. When the generation of scientific knowledge was explicitly linked to development projects, this system was then shown to be essential for training of companies and construction of strategic national sectors. It made possible the system to support the aerospace industry at Embraer, refining and extraction at Petrobras, agricultural training at Embrapa and, more recently, support for the China-Brazil satellite program. In all these projects, the presence of the state was – and, albeit in different ways, continues to be – fundamental.

Since the 80's, however, Brazil has sought new paths after exhausting the developmental cycle. The new realities for an open economy, where the degree of protectionism is significantly smaller, added to the difficulties of state funding, and pushed the Brazilian economy, especially the business sector, to compete for innovation. Despite the steps taken in this direction, the still low level of innovation that permeates the economy and the majority of Brazilian companies is cause for great concern, especially if observ-

ing that China and India, direct competitors of Brazil in international trade, are making faster and wider strides in this direction.

It is true that Brazil increased its expenditure on R & D – today around 1% of GDP – but China, since 2005, moved to third in ranking of investment (as measured in PPP – purchasing power parity), with a growth rate of 18% per year between 2000 and 2005⁶. At the same time – and this is one of the great weaknesses of the Brazilian economy – the private sector still accounts for the smallest share of this investment, unlike the average for OECD countries (performance: 63% and financing: 68%), and very different compared with the Indian and Chinese reality.

Brazil has, however, a differential condition in the world. It has a large consumer market and has a relatively large industry with about 90,000 industrial firms with more than 10 employees, employing more than 6 million workers and investing about \$ 3 billion a year in R& D. These indicators highlight Brazil when compared to the average in developing countries.

It is evident, however, that the technological innovation indicators in Brazil are far from developed countries and even some emerging countries of Asia. In Brazil about 30% of companies are innovators. The average of this share in European Union countries is 50%. About 6,000 Brazilian companies made expenditures for R&D. Brazilian companies have invested 0.6% of revenues in R&D. In Germany this percentage is 2.7% and in France is 2.5%. Less than 3% of Brazilian industrial firms brought some product innovation to the market and less than two hundred innovate for the international market.

The biggest dilemma, no doubt, is in the private sector, because Brazil's economy is still far from developed and developing countries, and remains well behind countries such as Korea, India and China. Research, national and international⁷, shows that innovation policies in Brazil also remain:

- Very oriented towards basic research;
- Very general and do not take into account the different characteristics of companies that have greater potential for innovation;
- Encounter difficulties to stimulate and enhance a large variety of innovations that are the backbone of the major economies.

The studies are clear to point out that despite the recent institutional improvements, the innovation system is still inefficient to transform the knowledge generated in research centers and universities into technology, products and services that impact on the economy.

Innovation, Basic and Business Research

There is no doubt that Brazil has advanced the relationship between Companies and basic research. Without intending to exhaust the subject, we must emphasize the importance of the creation of Sector Funds in 2001 for the financing of S&T&I in Brazil. The need for stable sources of funds for financing the activities of science and technology in Brazil was one of the factors that led to the emergence of the Sector Funds that today sustains the National Fund for Scientific and Technological Development (FNDCT).

The direction of these resources for knowledge generation connected to technological innovation is a key concern of public institutions. But the number of researchers working on technological innovation remains small and they still seek closer relations between universities and companies.

The first evidence in this direction has been found in recent studies that mapped the PhDs connected to groups of research grants and the coordinators of the projects approved in the Sector Funds⁸. There are 24,645 research groups registered in the CNPq Directory. Among these groups, 2,922 groups reported interactions with 4,483 companies and 1,137 companies in the services sector (excluding education) and industry.

Among the Sector Funds⁹, 13,435 projects were supported between 2002 and 2008. 20.1% of funds were disbursed from Sector Funds, that is approximately \$600 million was allocated to project managers, PhDs linked to research groups in the CNPq which relate to business services sector and industry. This is a relevant indicator of the university/industry link and for evaluation the mechanisms of the funding system for S,T&I in Brazil.

The difficulties of this connection become even more evident when examining the sources of R&D companies. According to PINTEC (IBGE), companies that invest in R&D in Brazil make this effort with more than 90% of their own resources. That is, although the State is responsible for more than 50% of expenditure on R&D effort, R&D in companies is mostly done without adequate sources of

financing. In developed countries the government funds R&D largely by non-recoverable or zero interest, that is, under much more favorable terms than in Brazil.

Unlike what is often propagated in the universities, the investment of public resources in R&D in companies is extremely positive for the development of the country. Several studies demonstrated that the Program for Support for Technological Development of National Companies (ADTEN) and FNDCT Co-FINEP between 1996 to 2005 had a highly positive impact on the productivity of companies and their spending on R&D¹⁰. When compared with similar companies that did not have public support, studies have shown that public programs have induced significant changes within companies' performance, either in quality of wages of work. In addition, there was what we call "additionality effect" as companies supported by ADTEN invested 54% more in R&D from their own resources than similar companies that did not receive public support. Those supported by the Cooperative FNDCT-invested 104% more own resources in R&D. The increase in private spending on R&D shows that there isn't, in the Brazilian case, substitution of less expensive public resources for private ones; on the contrary, there is an addition of private resources, or, in other words, businesses receiving public resources invested more of their own resources. Although these results are largely positive for the Brazilian development, the scope of current programs is still very limited in terms of number of companies assisted.

Some data from PINTEC, collected by IBGE, translate some of these weaknesses into numbers:

■ Brazilian industry innovates much less than developed countries. The degree of innovation, understood as companies when companies begin marketing a product and / or new process or improvements in the three years preceding the survey, was around 35% in 2005. Although linear comparisons cannot be done, given methodological differences, in seven countries surveyed by the Observatory for Innovation / ABDI (United States, Canada, France, United Kingdom, Ireland, Finland and Japan), the average for the same year was about 60%¹¹.

■ Expenditure on innovation in Brazilian industry is relatively high, however spending is directed mainly for purchase of new equipment and not for R&D performed within the company. If we take the expenditure on R & D performed by companies directly (as a percentage of its revenues), Brazilian indicators, despite the wide range of

incentives, exemptions and special programs run by public institutions, remained virtually unchanged over the past fifteen years (around 0.6% in the last three PINTECs).

■ The Venture Capital market is still in its infancy in Brazil – despite recent efforts by BNDES. In the most innovative countries, venture capital funds are a determining factor in inducing entrepreneurship.

Acceleration is Needed

The advances made possible by PITCE, in 2004, and by adoption of the Innovation Law and the Law of Goods, combined with a number of other instruments and legal, tax and institutional factors have significantly improved the economic environment for innovation in country. The subsidies, historically over-valued, combine to present a more balanced way with new instruments of direct incentive to R & D and tax relief to the most depressed (like those linked to information technology and communication), through special programs for the production of drugs and medicines, as well as reinforcing and strengthening the relationship between universities and companies.

The evaluation of recent initiatives related to tax exemptions also show that tax incentives induce investment in R&D of Brazilian companies.¹² It is estimated that tax incentives programs for R&D in Brazil generate increased spending in participating R&D in 90% of cases. Tax incentives are widely used by developed countries to boost spending on R&D.

R&D funding in companies is universally used to induce development. Several countries have mixed funding under special agreements, such as in South Korea, Finland, France and Japan. Many countries make intensive use of government purchasing power, as in the United States. New legal instruments increasingly broaden the scope of funding programs for R&D in Brazil. With the new legal instruments (especially the Innovation Law and Law of Goods), and with the increase in the implementation of Sector Funds, FINEP supported 923 companies in four years. If we consider the Program Grant (2008) FINEP financed 1,132 enterprises in four years¹³. This is an enormous amount compared to the past in Brazil, and is a great deal for FINEP, but small compared with the standard in advanced countries.

Even in critical areas where faster progress is required and where there is still much to be done, such as the process of patenting, there is a positive effort to spread of a new culture that would allow Brazil to increasingly participate in the globalization of the value chain.

In the Brazilian case, it is key that a portion of the business community has awakened to the significance and necessity of innovation.

Studies have identified¹⁴ a number of companies that differ from the historical pattern and performance displayed by the Brazilian industry.

These companies adopt new strategies in relation to exports and labor based on a more durable innovation process. This is true of even small companies, 1.7% of industrial enterprises of national capital, e.g., about 1,200 companies from different sectors. However, despite the small number, these companies have performed very significantly, since they account for more than 25% of sales in the industrial sector. According to data submitted by the IPEA, the new enterprise group distinguishes itself by: i) obtaining a special price on the international market compared to other Brazilian exporters ii) being productive iii) investing more in R & D and paying better wages to employees iv) investing more in training and capacity building; v) growing faster than other Brazilian companies.

The pace of technological innovation in Brazil is still able to generate employment, income and better paid and more stable jobs. Approximately 30% of Brazilian industrial companies make a product or process innovation every two years. According to information from RAIS (Ministry of Labor), industrial companies that innovate and differentiate their products pay 80.5% more for their workers than the average of workers employed in the industry. The jobs generated in companies that innovate and differentiate products require 20.9% more education for workers. The average stay of workers in these industries is 30.4% higher than average. Firms that innovate and differentiate their products will pay 23% wage premium for workers who have the same level of education and the same occupation in the same industrial sector¹⁵.

Many of these companies, besides having incorporated exportation into their growth strategies, began to internationalize their activities, investing outside of Brazil, building systems of production and services abroad, forming a select group of Brazilian multinationals.

The data revealed shows that the Brazilian productive structure is undergoing transformation. This recent development adds to the responsibilities of managers and policymakers, who need to be aware of the diversity and different skills of our economy.

Under these conditions, the innovation appears to be the only way to lift and support the level of competitiveness and the Brazilian economy. Precisely for this reason, all incentives to do so must be intensified. Without this dimension, the entire development agenda will be crippled.

New Challenges

If the challenges to Brazil were never small, then today they have become gigantic, going beyond general policies, to deploy and spread in private and public areas a new culture for the permanent differentiation in the domestic and international market. The past, in this case, operates as a burden to insure future outcomes. This begins with the changes in the power of the Union, because it was a time when it was possible for the government to put the engines of the economic development to work. This is not to identify the state as a villain to be neutralized, but to recognize that the state, despite its weight and importance, cannot afford to think, formulate, implement and evaluate new development policies without consultation, cooperation and interaction with business and civil society.

The Brazilian state no longer has the ability to act as a substitute for a business (as was believed in the past), or in place of a society that does not want or need to be replaced. The social, political and economic foundation of the old developmentalism changed. The "rules of the game" of the 40's to 80's, in the words of North¹⁶, aged and lost their effectiveness. To face the challenges of the twenty-first century, the institutions generated by the developmentalist state must be revised, restructured and resized in order to make way for a society aligned with the times.

Not infrequently, throughout the 90s, the short-term view prevailed in politics, business and in large part of public organs. It generated illusions and false dichotomies, such as an opposition (not always reasonable) between market and state. Fortunately, this debate has reached a new level. And though still controversial, the topic can evolve towards the recognition that the private and public sector needs to seal a new commitment to the country, mainly because Brazil needs new syntheses, more aggregated and less

polarizing. Examples of development pacts that changed the face of many countries are abundant.

One of the key challenges for public policy in Brazil is to integrate the instruments to promote technological innovation in various institutions of the Brazilian State. This is only possible if the State has a strategic innovation policy. Whether or not there is boldness in business strategies also depends on the spread and entrenchment of this future vision.

To construct an innovation friendly economy

Real changes are known to occur in unstable environments and do not tend, in general, to follow rules or obey the manuals. Therefore, it is naïve for public managers, entrepreneurs or researchers to imagine that an eventual return to the interventionist state of the 50's, 60's and 70's would pave the way for the Brazilian economy and would overcome the chronic failures of the market.

The national developmentalism, with the substitution of imports, state-run companies and hyper-centralization of the economy, moved the state and drove Brazilian industrialization. But it is true that it also suffocated much of our productive system, broke the momentum of competitive industry and has been at the root of a series of crises that have eroded the country over the past 30 years.

One of these crises is related to the loss of flexibility of state action, the result of the inflexibility of an institutional architecture that has become inadequate and insists in giving us examples of ongoing aversion to change. More relevant than the many deficits in the economy appear throughout its history, Brazil is experiencing an institutional deficit that became clear with the need to rethink our development.

We're talking about a process of searching for a new national configuration of policies and instruments capable of steering Brazil in the midst of globalization and economic systems that have knowledge as its backbone. It is therefore much more than an appeal for a rigorous narrative of our history.

In Brazil, industrialization became the main inspiration of social evolution. And in a sense, this still remains. These roots have marked state institutions and are the modus operandi of government planners. The Brazilian economy

has come to be seen as divided into industrial sectors, which need only to be inserted into the supply chains of developed countries. According to this view, the institutions of state, repeatedly, were organized to meet and encourage these sectors, which left deep traces in the formation of values, attitudes and behavior in the public and the business world. Only recently have public institutions started to rethink their policies and actions to modify the structure of production and services in the country. The recent emphasis on innovation comes from that very recognition of a need to diversify the economy, to expand exports, to increase the technological density of what the country must do to increase productivity and competitiveness.

Innovation policies have earned a place in the framework of transformation of the system of industry, in agriculture and services. More is needed, however, if the country does not once again want to miss the opportunity to take a leap forward in its development. A level playing field between the public and private sectors is needed to construct an effective innovation-based economy.

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Endotes

1See Arbix, G. (2007)

2See De Negri, J. A. e Salerno, M. S. (2005) .

3See De Negri, J. A., Esteves, L. e Freitas, F. (2007)

4E. Rogers (1995)

5S. Kline and N. Rosenberg (1986).

6OECD, 2008.

7See Rodriguez, A., Dahlmann, C., Salmi (2008) and OCED (2008) and Mobit (2007).

8See De Negri e Lemos (2009).

9Includes all projects that had at least 20% of its planned resources disbursed. The total of these projects was R\$ 4.49 billion, with about R\$ 3 billion executed.

10De Negri, J.A., Lemos, M.B. and De Negri, F. (2008³) and De Negri, J.A., Lemos, M.B. and De Negri, F (2008b)

11Research: Strategies of Innovation in Seven Countries: EUA, Canada, France, UK, Finland, Ireland, and Japan (MOBIT), executed by the Observatory for Innovation and Competitiveness.

- 12Avelar A.P. (2008).
- 13Dates from Jan. 2005 to Oct. 2008.
- 14See De Negri e Salerno (2005)
- 15Bahia, L (2005)
- 16D. North (1990)

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