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PROSPECTIVA
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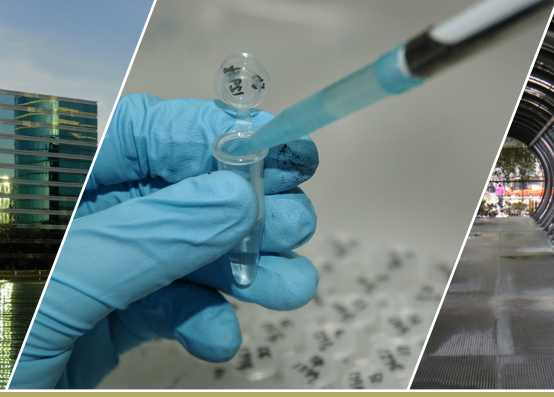


MARCH 2008

BRAZIL INSTITUTE AND THE PROGRAM ON SCIENCE, TECHNOLOGY, AMERICA, AND THE GLOBAL ECONOMY

Innovation in Brazil: Public Policies and Business Strategies

EXECUTIVE SUMMARY

Fostering innovation is one of the key challenges Brazil faces as the country strives to emerge as a force in the global economy. In the twentieth century, Brazilian scientists and research institutions developed and established the country's capacity to produce state-of-the-art knowledge in various fields. Innovation, or the ability to apply knowledge in the development and production of goods and services, however, remains largely absent in many sectors of the economy. To address this issue the country needs to advance public policies on science and technology that help translate the country's strong research base into products and services that benefit consumers and society at large. Better public policies create incentives and foster the necessary environment that will support companies in their effort to turn ideas into competitive products and services.

Written by
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This conference was the second of three sessions dedicated to the question of innovation in Brazil convened by the Brazil Institute and the program on Science Technology, America and the Global Economy (STAGE) of the Woodrow Wilson Center. It brought together top researchers, government officials, and business leaders to analyze the country's current efforts and future prospects for developing a comprehensive and advanced national innovation system. Panelists discussed the critical role businesses play in the ever changing process of innovation and assessed different strategies available to governments seeking to promote innovation from both a domestic and global perspective.

THE CHALLENGE OF INNOVATION

Director of the Brazil Institute *Paulo Sotero* opened the discussion by highlighting the complexity of developing cohesive innovation policies. Future steps in building Brazil's innovation system will be affected by developing innovation systems in China and India as well as by developments in the OECD countries. Decisions by governments to increase their investments in research and development, improve their innovation systems or stimulate public-private partnerships can be guideposts and opportunities as well as challenges for Brazil. As more and more countries develop or improve their innovation systems and the research community becomes more global, it is less and less possible for a single government to "impose lessons" upon others.

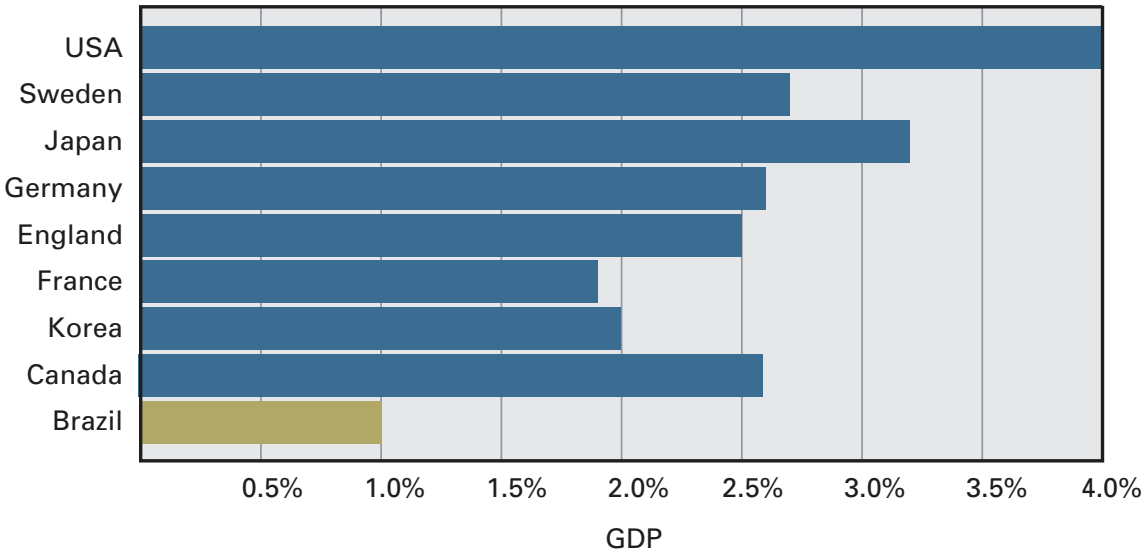
Changing Dynamics

Carlos Américo Pacheco, assistant secretary for development of the state of São Paulo, contextualized the debate within the historical role innovation has played in human development and discussed how transformations in the international economy have shaped nations' approach to innovation-oriented public policies. He explained that innovation is not a new phenomenon; "technological progression and the development of new tools have been central to the evolution of mankind." What is new about the modern-day focus on innovation is the scale of and speed with which technical knowledge and scientific advances have taken place. Globalization has increased the competitiveness of countries and corporations integrated into the world economy, which, in turn, has sharpened the need for innovation—making it a central pillar for any public policy aimed at economic development and industrialization.

GLOBALIZATION HAS INCREASED THE COMPETITIVENESS OF COUNTRIES AND CORPORATIONS INTEGRATED INTO THE WORLD ECONOMY, SHARPENING THE NEED FOR INNOVATION.

Pacheco contrasted the role of contemporary innovation policies with the industrial policies adopted shortly after World War II. Whereas industrial policies in the post-war period were primarily geared towards developing large state-owned companies in so-called "strategic industries" and protecting domestic production from foreign competition, the globalized nature of today's international economy makes the crafting of innovation policies extremely complex. Gone are the days when government's can simply "engineer" policies that target specific types of innovation; technological and scientific advances, which are critical components of sustainable economic growth, are now primarily driven by market demand. Yet, while firms are the principal engines of innovation and policy-

FIGURE 1. R&D Spending as a Percentage of GDP(2003)



Source: UNESCO

making is "still grounded in economic considerations," the best players in the international arena are those that have developed a "national system of innovation" where the increased number of actors—companies, governmental institutions and research centers—fluidly interact within a cohesive network.

Integrated National Strategies

Within this network, Pacheco elaborated, government institutions—and particularly a country's macro-regulatory framework—play a pivotal role. Take, for example, the central role the U.S. Federal Drug Administration (FDA) plays in the pharmaceutical industry. Not only is the FDA's commitment to protect intellectual property (IP) crucial for the development of new knowledge and products, he stressed, but the agency also helps shape the "nature of firms in the market," the incentives and disincentives for entrepreneurship, as well as firms' exposure to risk and access to credit—all of which are critical components of an industry's innovative capacity.

Nonetheless, observed Pacheco, to truly succeed as an international competitor the "complexity of the entire innovation paradigm" requires government's to adopt a more holistic approach to public policy. That means increasing capital and labor mobility, public and private sector cooperation, as well as provisions of public goods like "technological infrastructure." It also means providing direct incentives for businesses (especially medium and small businesses) to enhance innovation and encourage risk-takers (angel investors, venture capitalists, etc.) to commit seed-capital to start-up companies; establishing tech-parks and business incubator programs; stimulating cooperation between businesses and universities; and promoting the commercialization of

intellectual property. A coordinated national strategy that integrates these different policies into one cohesive framework should therefore be a top-priority for the Brazilian government, argued Pacheco.

Pacheco highlighted that Brazil's approach to innovation has produced mixed results: on the one hand the country's system is underdeveloped and fragile, on the other hand, the country has managed to make significant progress in this field. One particularly telling sign of such progress is that the term *innovation* is now an "explicit" item on the government's agenda. Prior to 2001, he remarked, government agencies responsible for advancing scientific knowledge only considered the issues of "science and technology"; now, the focus for these agencies is on "science, technology and *innovation*." Trade organizations as well as business groups and associations have gone through a similarly transformational process: their lobbying efforts have led to fiscal policy reforms and adoption of new laws aimed at spurring innovation. Moreover, Brazil has a set of companies with proven innovative capacity, he emphasized. Despite Brazil's "fragile" industrial base for innovation, a 2005 study by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute for Geography and Statistics) showed that nearly 33 percent of Brazilian firms are considered "innovative," meaning that within a given calendar year they have developed a new product or service.

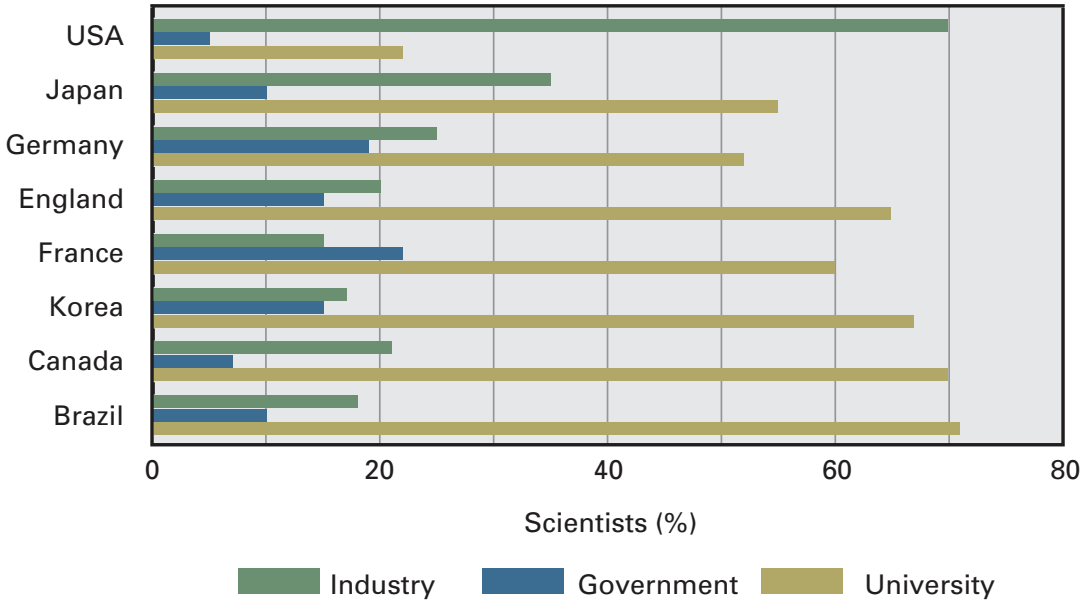
With the rise of Asia and China as the world's manufacturing hubs and the pressures of an appreciating *real* (Brazil's national currency), the need for Brazil to scale-up its level of production, develop "higher levels of value-added production, and reinvent the trajectory of its manufacturing sector" is more imperative than ever. Pacheco emphasized that for the country to succeed—and become a greater force in the globalized economy—it must employ integrated innovation policies in a way that exploits its comparative advantages and ample natural resource base.

WHILE UNIVERSITIES PLAY A PIVOTAL ROLE IN THE INNOVATION PROCESS BY SERVING AS CENTERS OF RESEARCH AND ANALYSIS, THEY SERVE A MUCH GREATER FUNCTION IN THE SYSTEM AS PRODUCERS OF HUMAN CAPITAL.

The Role of Knowledge

Carlos Henrique Brito Cruz, scientific director of the *Fundação de Amparo à Pesquisa do Estado de São Paulo* (FAPESP—the São Paulo Research Foundation), provided general comments about the process of innovation in Brazil and around the world. He discussed the continued discrepancy between Brazil's impressive ability to generate knowledge and its failure to

FIGURE 2. Institutional Distribution of R&D Activity



Source: "Brazil and the Knowledge Economy," Brito/ FAPESP 2005/06

translate these ideas into tangible products and services. Brito Cruz concurred with Pacheco's historical analysis of the role of technological development, adding that the economic focus on innovation was not widely established until after the communications revolution of the late 1990s, driven by the internet.

Brito Cruz criticized the tendency in Brazil for discussions on innovation policies to only focus on the part played by universities. While universities play a pivotal role in the innovation process by serving as centers of research and analysis, he explained, they serve a much greater function in the system as producers of human capital. Individuals with higher degrees of education provide the country with a dynamic workforce that is "better able to use, adapt and co-opt knowledge" generated by new ideas and scientific advancement, as well as a more informed consumer pool interested and able to purchase new products.

Moreover, Brito Cruz stressed the central players in an innovative economy are not universities, but rather firms. Brazil has had a legacy of neglecting the importance of businesses in this process; up until 1999, the government assumed that universities were adequate substitutes to pick up the slack in research and development (R&D) not carried out by the private sector. As a result, universities dominated the country's public discourse on innovation-oriented policies—skewing policies in their favor.

Turning Knowledge into Products

To elucidate his point regarding the importance of the private sector, Brito Cruz contrasted the

GOVERNMENT MUST RECOGNIZE THAT BUSINESS IS THE PRIMARY DRIVER OF INNOVATION AND POLICIES SHOULD BE SHAPED AROUND THIS REALITY.

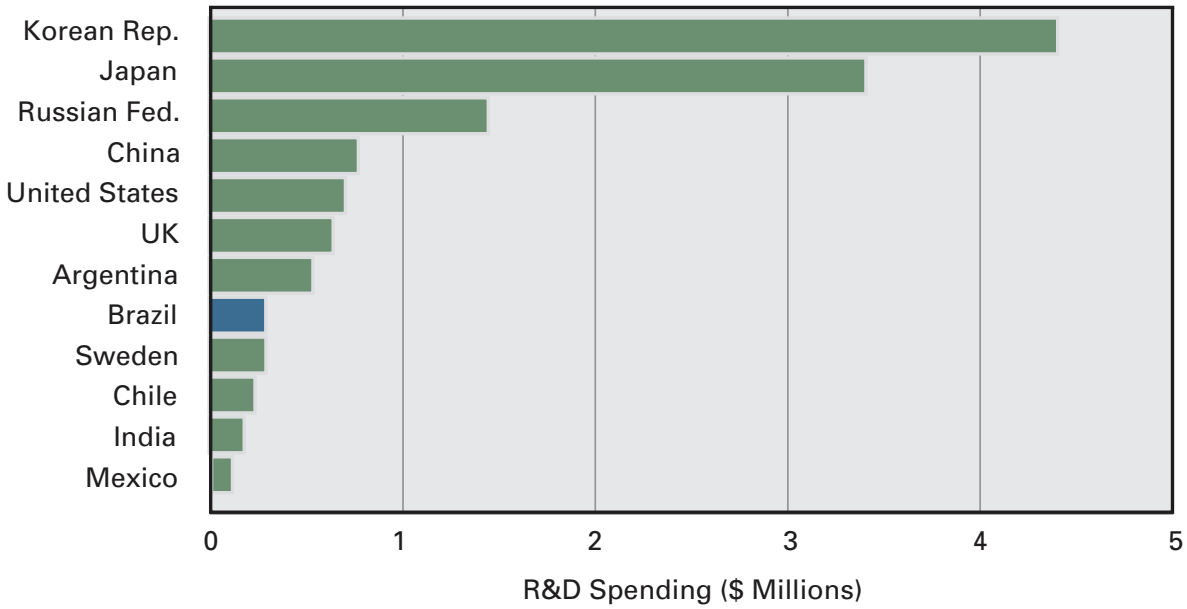
Brazilian experience with that of Latin America and other comparable and important countries, focusing particularly on Spain. He noted that in the state of São Paulo—the focal point of his research because the state is responsible for over 55 percent of the scientific knowledge produced in Brazil—more scientific publications (the measure used to benchmark "scientific knowledge") are produced than in any other country in Latin America. Mexico, the region's second highest producer, published about 4,500 articles in 2004, which is roughly 1,000 less than São Paulo. Furthermore, the state boasts an impressive number of PhD graduates: the University of São Paulo (USP) and Unicamp graduated 2,041 and 873 PhD candidates in 2004, respectively. The University of California at Berkeley, the next highest contender, graduated 769 PhDs in the same year.[1]

Yet, despite the state's high level of scientific knowledge (an important measure of a country's innovative *capacity*), Brito Cruz observed, it lags far behind other competing countries in the number of patents developed. And patents, argued Brito Cruz, are better measures of a nation's ability to translate innovative capacity into concrete "knowledge-based" goods. Take Spain for example, a country with significantly fewer PhD graduates. Whereas the number of patents registered by São Paulo in the U.S. Patent and Trade Office has grown slowly since 1982, reaching a peak of approximately 75 in 2004, Spain in the same year registered over 300 patents, or more than 6 times the number of patents it registered in 1982.

Brito Cruz cited two important factors to explain this discrepancy. First, Spanish companies invest more money in R&D than Brazilian ones. Second, far more Spanish scientists are employed in the private sector than in Brazil (about 60 percent of Spain's researchers are employed by firms, in Brazil less than 23 percent are). Research has shown that both factors are positively correlated with successful innovation strategies. Companies that invest more in R&D produce more patents; the more scientists a country employs in private firms, the more patents the country registers, explained Brito Cruz. To further underscore the centrality of businesses in the production of knowledge-based goods, he cited trends in the patenting process in the United States. Despite the popular notion that universities are the drivers of research and discovery, in 2003, universities accounted for only four percent of registered U.S. patents.

Brito Cruz stressed that it is imperative for Brazil to adopt appropriate policies that recognize the leading position firms occupy in the process of innovation. Among other initiatives, the Innovation Law—submitted to Congress

FIGURE 3. Patent Filings per $Million R&D Expenditures 2004



Source: WIPO 2006

by President Fernando Henrique Cardoso in 2002 and signed into law two years later by President Lula—was a particularly important step in the right direction. The law, which increased academic IP rights, encourages greater university-industry joint R&D ventures and stimulates industrial R&D by providing tax incentives, subventions and subsidized loans. It also established a critical precedent, *continuity,* which is arguably more important than the substance of the policy. The fact that the law was drafted and submitted under FHC, then signed by President Lula, signifies how seriously the government takes this issue and lends greater confidence to the government's long-term strategy. Further institutionalizing these governmental policies will spur the country's innovation system by increasing industries' confidence in the government's strategic commitment to develop a favorable national environment for innovation—a much needed assurance to mitigate the business risks associated with investments in innovation.

GLOBAL PERSPECTIVES ON INNOVATION

Moderator of the conference's first panel and Executive Director of Prospectiva International Consulting *Ricardo Sennes* stressed that innovation is key to a country's international strategy. Unfortunately, he remarked, there is a growing gap between Brazil's domestic policy agenda and its conduct in the international arena. On

the domestic front, Brazil appears to be making great efforts to encourage innovation through rigorous IP protection and an integrated network of institutions, laws and norms. Yet, in the international arena, the country seems to disregard many of these same principles, preferring protectionism and reactive diplomacy.

Shifting Patterns in U.S. Policies

Stephen Merrill, executive director of the United States National Academy of Science's Board on Science, Technology, and Economic Policy (STEP), reflected on Brito Cruz and Pacheco's analysis of innovation and concurred that, indeed, constructing, "engineering," or creating incentives for appropriate policies is very complex. Ensuring that those involved in the innovation process can trust the "integrity of policymakers and policies, as well as the competency of institutions, certainly requires continuity of policy." Moreover, Merrill added that the reason policymakers might overemphasize the role of government and academia at the expense of the private sector, is that both entities are easier to manage and deal with, and implementing policies—regardless of their effectiveness—has political benefits.

RECOGNIZING PATTERNS IN POLICY SHIFTS IN THE UNITED STATES, EUROPE AND PARTS OF ASIA CAN HELP BRAZILIAN POLICYMAKERS AND STAKEHOLDERS DEVELOP THE MOST EFFECTIVE NATIONAL INNOVATION STRATEGY.

Merrill focused his discussion on the evolution of the innovation system in the United States. Changes in the United States reflect broader, underlying patterns that are shifting the way innovation works, he said. Merrill underscored the United States' leading position on innovation. Quoting George Mason University Professor Christopher Hill and speaker at the Brazil Institute's first conference on innovation in June 2007, Merrill stated that for "over a half century… (U.S.) firms have mastered wave after wave of new technologies, from aerospace and electronics to pharmaceuticals and nanotechnology. These successes were built on a strong foundation of new knowledge…(and) have benefited from the establishment of a highly supportive national innovation system." Merrill added that the United States has fairly consistently topped indices that measure countries' innovative capacity, citing its first-place ranking in the recently released World Economic Forum's 2007-2008 Competitiveness Index, as yet another example.

What makes the U.S. national innovation system (NIS) so successful? Part of the explanation, Merrill noted, can be found in the various, complimentary elements of the country's NIS. Specifically, the role institu-

INNOVATION IS STIFLED BY OVERLY ACTIVE BUREAUCRACIES AND REGULATORY REGIMES WHICH EXPLICITLY ENCOURAGE THE USE OF CERTAIN TECHNOLOGIES OVER OTHERS.

tions (public, non-profit and commercial) play in performing R&D; the availability of capital and sophistication of financial actors that invest in technology-based start-ups; the robust intellectual property regime and strict enforcement of IP rights; business-friendly tax policies as well as the compatibility of technical and regulatory standards. Another important factor to consider, Merrill stressed, is that while "U.S. innovation institutions and policies are in continual flux for reasons tangential to innovation concerns, from time to time they are brought under review systematically [sic] in response to perceived foreign challenges." This was certainly the case with the aggressive development of America's space program and expanded federal support of graduate education—a direct response to Russia's successful launch of Sputnik in 1957. In 1980, the Innovation Domestic Policy Review initiated by President Jimmy Carter was a result of the perceived threat posed by Japan's manufacturing prowess. Today, India and China loom large in the minds of policymakers who fear the balance of technological and scientific power may be tilting East. As a result of a series of reports[2] and the perceived threat from the East, policymakers passed legislation authorizing a variety of measures: increasing public R&D; providing more generous tax incentives for corporate R&D; and improving both basic and higher education in science, technology, engineering and math.

Merrill also analyzed other issues driving change within the innovation process from "the perspective of the firm." According to his analysis, the United States is increasingly seen as a high-cost R&D location with comparatively less unique R&D capital and human resources. Furthermore, the globalization of investment and growing use of outsourcing as a necessary business practice, has broadened the pool of knowledge available outside the United States and decreased the attractiveness of investing in America. Perhaps more significantly, he said, firms consider "innovation to be less reliant on natural sciences and engineering, and more on social science, art and new business practices."

Changes in the Innovation Paradigm

As a result of the evolving nature of innovation and increased foreign-based competition, several new topics have entered the national debate. Now there is pressure for the government to improve measurement of innovation performance, support investment in *intangible* assets in addition to R&D, and reform intellectual property policy features of the regulatory process. Merrill stressed how these issues exemplify the changes underlying the innovation process. Regarding regulatory reform, he

alluded to comments made by Pacheco, and observed that an overly active bureaucracy and regulatory regime which explicitly encourage the use of certain technologies over others generally stifle innovation. A more successful approach is to provide industries with specific benchmarks that establish guiding standards and norms but allow individual companies and market demand to determine which technologies would most efficiently yield the desired policy result. A common example is setting a minimum standard of miles per gallon that new cars must comply with in hopes of producing more efficient vehicles.

On the issue of IP rights, he remarked, there is a growing division concerning the measures adopted over the past 25 years that have strengthened and extended patent protection and contention over what steps should now be taken to modify that course. One interest group—led by the software, computer services and finance sectors—is lobbying for various reforms which include an open-ended, post-patent challenge process; limiting damages for IP infringement to account for an invention's contribution to a product; and limiting injunctions when infringements are found. Another coalition, headed by the biopharmaceutical and "old-style manufacturing" sectors, opposes each of these measures. This division suggests just how disruptive innovation politics and policy changes in the innovation system may be. These changes also have implications for emerging economies like Brazil. Recognizing patterns in these policy shifts can help Brazilian policymakers and stakeholders develop the most effective national innovation strategy and help the country absorb the emerging character of innovation in the global economy.

Emerging Giants: The Role of India and China

Kent Hughes, director of the Wilson Center's STAGE program, discussed India and China's growing influence in the field of innovation and noted that the trajectories of both countries will affect policies and strategies of developed and developing countries alike. Hughes explained that globalization has changed the structure of the international economy, bringing about opportunities for emerging economies not only to be niche producers of technology-based goods but also generators of knowledge. As the process of research and development "has gone global," both India and China's strong base of skilled technicians, engineers and scientists make the countries attractive locations for foreign direct investment (FDI) and regional R&D centers for global companies.

This changing dynamic has led both countries to develop ambitious innovation strategies, he observed. Every year, China is estimated to graduate over 600,000 engineers and skilled technicians with post-secondary school education. The country also plans on establishing over 1,000 high-caliber research universities. China's broader focus on improving education, especially higher education, has been paying off; China currently ranks second in the number of scientific papers published on the issue of nanotechnology. India is aware that new, lower-cost competitors are bound to chip away at its comparative advantages—shifting low-cost call centers to other countries—and plan to scale-up production to compete in sectors with higher-value services and production. Aside from improving the country's education system, Hughes added, India has placed greater emphasis on business schools and managing technology, hoping to build on its IT/business

services base and to expand and diversify the country's productive capacity.

THE BUSINESS SIDE OF INNOVATION

Luiz Henrique Braido, professor at the Getúlio Vargas Foundation and moderator of the panel on business strategies, commented on the increased attention the issue of innovation has received in the field of economics. In past decades, economists attempted to explain the discrepancies in GDP across the world by focusing on the distribution and use of capital and labor. Today, the notion of productivity has arisen as a major explanation for this disparity. Many studies indicate that as much as 50 percent of the variation in household income around the world can be explained by the difference in use and availability of technology, he averred.

Venture Capital: Sparking Innovation

Fernando Reinach, executive director of *Votorantim Novos Negócios* (VNN – Votorantim New Ventures), assessed the critical role of venture capital in the development of new products and services. In order to understand how new discoveries translate into tangible products, Reinach emphasized the need to better comprehend the investment process required to finance such projects. Using VNN—a risk-capital fund developed by the Votorantim Group to diversify its business portfolio—as a case study, he described the process in clear economic terms: "given the higher level of risks associated with venture capital (VC) funds, these funds need to generate much higher levels of return than traditional capital investments."

GLOBALIZATION HAS CHANGED THE STRUCTURE OF THE INTERNATIONAL ECONOMY; EMERGING ECONOMIES THAT USED TO ONLY BE NICHE PRODUCERS OF TECHNOLOGY-BASED GOODS ARE NOW ALSO GENERATORS OF KNOWLEDGE.

Whereas a standard investment to build a cement factory is based on predictable and reliable cost and profit estimates, venture capital investments in innovative areas such as biotechnology are characterized by uncertainty and volatility. Considering the rigorous selection process VC funds utilize to determine which projects to fund, Reinach noted that investors and stakeholders must have enough confidence in the viability of capital investments in order to be willing to "absorb its inherent risks and costs." The problem with innovation in Brazil is not these inherent risks and costs associated with the process of product development, but rather the added costs that result from the country's

FOR BRAZIL TO BOOST INNOVATION IN THE PHARMACEUTICAL INDUSTRY THE COUNTRY MUST AGGRESSIVELY MODERNIZE ITS INSTITUTIONS CHARGED WITH PROMOTING INNOVATION AND STRENGTHEN IP LAWS AND PATENT RIGHTS.

weak institutional framework and inadequate legal enforcement. Nearly six years after making its first investment in the biotechnology sector, the biggest challenge VNN's biotech ventures faces is patent infringement. Reinach explained that at this point in the maturity of the investment, the company's considerations should be focused on bringing new products to market, not fearing the legitimacy of its patents.

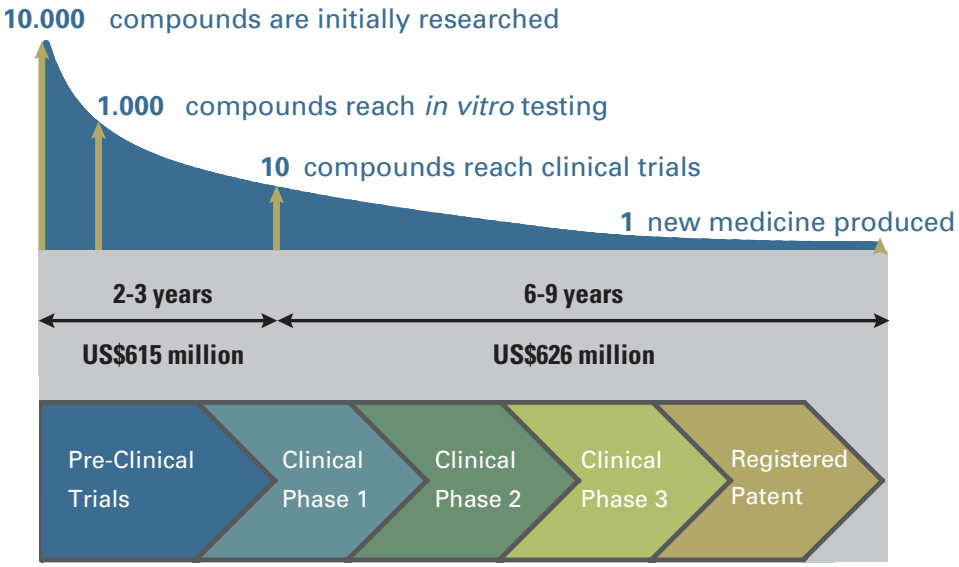
Reinach lamented that institutionally, Brazil has yet to develop a coherent consensus on how innovation will be treated. While the government has made efforts to decrease some of the risks associated with capital investments by offering a series of incentives—such as financial credit through the Ministry for Science and Technology's public financing company, *Financiadora de Estudos e Projetos* (FINEP – Research and Projects Financing) and the Brazilian National Economic and Social Development Bank (BNDES)—its inconsistent bureaucratic actions often disadvantage the very actors it seeks to support. For example, companies that develop revolutionary products in industries with no substitutes are often punished by regulatory agencies "for being monopolistic." Reinach concluded that these inconsistencies and contradictions serve to damage investor's confidence in the government's commitment to promote innovation and discourages future investments.

PHRAMACEUTICAL INNOVATION IN BRAZIL

Alexander Triebnigg, president of Novartis Brasil, evaluated the complex relationship between the pharmaceutical industry and Brazil. He emphasized the pharmaceutical industry's growing desire to expand operations in Brazil and highlighted some important developments. In previous decades, the Brazilian pharmaceutical industry focused primarily on its domestic market and specialized in the production of generic and replica drugs. Today, universities like Unicamp, which has submitted over 475 patent requests, and Brazilian companies Cristalia and Ache are actively involved in developing new, "cutting-edge" drugs—an important change that will help the country balance its negative commercial balance for drugs.

Nonetheless, Triebnigg recognized that the pharmaceutical industry faces significant obstacles to growth in Brazil. Bureaucratic bottlenecks in the approval of clinical trial protocols

FIGURE 4. The discovery and development of a new drug is… expensive, risky, and time-consuming.



Source: PhRMA and Tufts Center for the Study of Drug Development 2006

reduce Brazil's competitiveness as a destination for the development of clinical research—a bottleneck that not only hurts profits but the creation of new drugs as well. Furthermore, a continued public misperception about the process of research, discovery and innovation has tainted the drug industry; many citizens and non-governmental organizations view the motives of drug companies with suspicion. The issue of biopiracy is extremely problematic, Triebnigg noted, as it has embroiled Novartis in a legal and political battle which prevented the company from investing in a research facility in Brazil at that time. Also, the country's shaky record on IP protection—in May 2007 President Lula authorized a compulsory license for Brazil to use Merck's HIV/AIDS patent to produce a generic version of the drug Efavirenz—has discouraged investment in the pharmaceutical industry. For Brazil to fix some of these barriers, Triebnigg recommended strengthening IP laws and patents, and urged the country to more aggressively modernize its institutions, such as the Brazilian National Institute of Industrial Property (INDI), charged with promoting innovation.

Best Business Practices

Maurício Mendonça, chief executive of the Industrial Competitiveness Unit of the National Confederation of Industries, analyzed the intersection between business and Brazil's national innovation environment. He noted that Brazil has taken steps to spur innovation by adopting

THE PROBLEM WITH INNOVATION IN BRAZIL IS NOT THE RISKS AND COSTS OF PRODUCT DEVELOPMENT, BUT RATHER THE ADDED COSTS ASSOCIATED WITH THE COUNTRY'S WEAK INSTITUTIONAL FRAMEWORK AND POOR LEGAL ENFORCEMENT.

"subvention, equalization measures and better fiscal policies." Yet, "the number of companies that operate in this 'innovation niche' are still the ones that would do so regardless of these policies." Mendonça argued that part of the reason Brazil lags behind OECD members and other leading emerging economies is its "historical deficit of strong public policies"; aborting the country's nascent semi-conductor industry severely hindered the growth of industries producing technology-intensive goods.

Moreover, the country's current economic environment is not conducive for large-scale innovation. Mendonça cited the high tax-rate and fees levied on businesses, poor labor relations, limited availability of financing, and the complexity of fiscal incentives provided by the government and various other impediments to innovation. For firms to survive in this "harsh climate," he recommended they adopt a "long-term, strategic vision of innovation." This requires rigorous market analysis; managing partnerships with other firms, universities and government research centers; and adopting a business practice which benchmarks and compares a company's performance to that of its respective competitors.

Successful companies must be able to identify the economic and social demands of a market to better exploit its comparative advantages, argued *Mauro Assano*, executive manager of research for IBM Brasil. This process requires firms to identify which of three primary types of innovation—continuing innovation, disruptive innovation, revolutionary innovation—will increase its competitive edge. Each type requires a different strategy, he explained. Continuing innovation improves upon an existing product; disruptive innovation creates a substitute good (usually at lower costs) with the aim of stealing market share from an existing product; and revolutionary innovation is the invention of an entirely new product. Deciding upon the appropriate type of innovation will enable companies to create a portfolio of diverse potential investments and identify the most viable projects.

Sonia Tuccori, R&D manager for Natura discussed the integral function of R&D in the innovation system. She explained that the number of new products launched by her company is directly tied to the amount of R&D it performs. In 2002, Natura launched 91 new products; in 2006, that number climbed to 225.

During this same period, the company's R&D investments rose from USD$16.5 million to $49.25 million. Tuccori noted that Natura's focus on innovation relies on human capital and an integrated, comprehensive strategy. The company is dedicated to attracting the most talented employees: of its 210 researchers, 51 percent have either a Master's degree or a PhD, 32 percent have a Bachelor's degree, and the remaining 17 percent are formally trained technicians. Natura's innovation strategy has evolved with the changing demands of the global economy; whereas the company previously relied on a "closed-innovation" system where all new knowledge and technology was developed internally, it now follows an "open-sourced innovation" system where it collaborates with other firms and universities in the design and development of R&D.

Sérgio Risola, general coordinator for the University of São Paulo's Technology–Based Business Incubator Center (CIETEC), explained how CIETEC is a pioneering example of joint public and private innovation-oriented initiatives. The Center houses over 128 different science-based companies with the aim of "bringing together all of the players in the innovation process to generate knowledge and convert it into marketable products that benefit society." Risola argued that business incubator centers serve as an ideal vehicle for entrepreneurs. They bring together leading experts and provide them with the necessary resources, technical knowledge and training that allows them to better manage financial resources and the development of new companies and products in an "environment that promotes cross-pollination of ideas."

Olívio Ávila, executive director of National Association for R&D of Innovative Companies (ANPEI), assessed an often overlooked component of innovation: competition. Ávila referenced a recent study by MIT Professor Edward Roberts that determined nearly 70 to 80 percent of all cases of technological innovation are driven by market forces, or what is technically termed market-pull. Considering this fact, the government should therefore focus its efforts not only on financing innovation-based projects but on enhancing the country's international competitiveness by adopting a more export-oriented business strategy and encouraging businesses to "create stronger structural and managerial bases within the company." These internal mechanisms will allow companies—not governments—to determine which technologies and products offer the best chances to develop new markets or products.

NOTES

1. All statistics cited by Carlos Henrique Brito Cruz are the result of his original research at the Institute for Scientific Information.

2. Two of the most influential of these reports are The National Academies' Committee on Science, Engineering, and Public Policy publication "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future" (2005) and the (U.S.) Council on Competitiveness' "Innovate America: Thriving in a World of Challenge and Change" (2004).

Links to speakers' presentations, related documents, and statistics are available through our site, www.wilsoncenter.org/brazil/innovation.

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The **Brazil Institute** was created out of the conviction that Brazil and the U.S.–Brazilian relationship deserve greater attention within the Washington policy community. Brazil's population, size, and economy, as well as its unique position as a regional leader and global player, justify this attention. In keeping with the Center's mission to bridge the worlds of scholarship and policy-making, the Brazil Institute sponsors activities on a broad range of key policy issues designed to create a Brazil "presence" in Washington.

The **Program on Science, Technology, America, and the Global Economy (STAGE)** studies the impact of international trade, finance, and globalization on political and economic developments in America and the World.

STAGE also focuses on the growing importance of innovation, science, and technology policy in three complementary ways: exploring how technology can help achieve key national and global goals including health, energy security, and economic progress; assessing policy implications of emerging technologies; and examining the building blocks of long-term economic growth— including investment, life-long learning, global engagement, and innovation.

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Lee H. Hamilton, President and Director