Overview of Study “The Biopharmaceutical Research and Development Enterprise: Growth Platforms for Economies Around the World”

A new study by the Battelle Technology Partnership Practice examines the increasing efforts by other countries to grow their economies by focusing on the biopharmaceutical sector and related industries.\(^1\) As a research-intensive, knowledge-based industry, the biopharmaceutical sector supports high-wage jobs, generates exports, and is recognized by the U.S., and increasingly other countries, as an important contributor to economic growth and sustainability. While the U.S. has led the world in biopharmaceutical research and development (R&D) for the past three decades, an increasing number of countries are focusing on the biopharmaceutical sector and related industries in their economic development, innovation, and science and technology strategic plans. Battelle found that the U.S. is not improving on several key innovation indicators whereas other countries are seeing significant advances, suggesting that “the U.S. environment for innovation is showing signs of relative weakening compared with other nations in such areas as net output, exports, publications, and patents.”

It should be noted however, that a favorable environment for innovation also requires a number of aspects not directly addressed in this report including strong intellectual property rights and enforcement; a well-funded, science-based regulatory system; and healthcare payment and coverage polices that provide access to innovative therapies, among other factors.

**Key Findings:**

Battelle examined the policies and programs being implemented to promote innovation, with a focus on the biopharmaceutical and related sectors, in a mix of 18 developed and developing countries and the EU. These countries were selected because of their interest in growing an innovation economy through pro-innovation policies and programs and include those with an existing biopharmaceutical presence (Australia, Canada, France, Germany, Ireland, Israel, Italy, Japan, Sweden, and the UK), as well as emerging countries increasingly targeting the sector (Brazil, Chile, China, Russia, Singapore, Saudi Arabia, South Africa, and South Korea).

Battelle found that out of the 18 countries examined, all but two had innovation strategies in place to help grow a knowledge-based economy, with the majority of these plans targeting bioscience-related sectors for growth and development. More than half of the countries examined also had a separate strategy focused specifically on the development of the biopharmaceutical or biotechnology sector. These strategies largely aim to build the type of R&D infrastructure found in the U.S. and have generally focused on the following areas:

- Building R&D excellence and seeking to accelerate commercialization of research findings by constructing an R&D infrastructure;
- Ensuring access to financial capital for companies, particularly startups and emerging companies; and
- Attracting, retaining, and developing talent.

The study provided further evidence that the U.S. is the current world leader in biopharmaceutical research and innovation, helping fuel its leadership in biopharmaceutical economic activity.

- According to Battelle, the U.S. is responsible for:
  - 33 percent of all medical science publications generated worldwide.
  - 47 percent of all medical science patents filed under the World Intellectual Property Organization.
  - 70 percent of all biopharmaceutical-related venture capital deals.
- The U.S. share of new chemical entities (NCEs) during the last decade (2001-2010) was 57 percent, greater than the share of France, Germany, Switzerland, and the UK combined (33 percent).

Increasingly, however, U.S. competitors are recognizing the important economic and societal contributions of the biopharmaceutical sector and related industries and are implementing policies and programs designed to attract biopharmaceutical research and development activities inside their borders. The Battelle report provides insights into various countries’ innovation goals:

- As the President of the European Commission, José Manuel Barroso has stated “Europe needs an innovative R&D oriented and responsible biotech industry. An industry which is rooted in the middle of our societies, because it offers concrete solutions to its many challenges, because it offers high-quality employment, because it drives economic growth.” (Eropabio Meeting, December 2010, pg. 11)
- The Canadian Biopharmaceutical Industry Technology Roadmap also highlights the value of the sector, noting that “as Canada enters the 21st century, strategic investments in biopharmaceuticals will be increasingly important in improving the health and quality of life for Canadians [and] maintaining national prosperity…” (Letter of Transmission, 2006, pg. 13)
- Emerging nations are also committed to growing the sector, including South Korea, which recently stated on its InvestKorea web site that “if Korea fully utilizes [its] well maintained information infrastructure and excellent human resources, the [biosciences] industry is highly likely to grow into a core growth industry. Accordingly, the government is providing aggressive support for bio-R&D and infrastructure building.” (pg. 29)

The report found that a number of countries are focusing their innovation and biopharmaceutical strategies on the development of industry clusters, often in partnership with regional governments.

- Clusters are geographic concentrations of interconnected companies, suppliers, service providers, and related institutions in a particular field. Robust clusters foster innovation and positively influence regional economic performance.
- There have been only a few recent national-level programs to support regional cluster development in the U.S., while more than half of the countries examined have formal policies to support the development of regional industry clusters.
- As Battelle points out, cluster development is beneficial among biopharmaceutical firms because of the “particular specialized characteristics, capital requirements, unique talent needs, and long-term business commitment required for sustained growth,” that call for
“especially close ties between industry, clinical care, and academic research communities.”

Many of the countries examined are seeking to grow their biopharmaceutical sectors by fostering a robust R&D infrastructure through the implementation of R&D investment programs.

- According to Battelle, U.S. competitors are significantly increasing their investments in R&D, while future funding for U.S. R&D is uncertain and recently has been flat and has effectively declined. Battelle found that many countries that are pursuing innovation strategies set a goal of achieving a certain level of R&D as a percentage of gross domestic product (GDP). For instance, South Korea’s national plan calls for increasing its R&D investment as a percentage of GDP from 3.4 percent to 5 percent by 2012.
- The U.S. spent 2.8 percent of its GDP on R&D in 2008, ranking fifth behind Israel, Sweden, Japan, and South Korea. However, the U.S. ranked first in total R&D spending ($398 billion) followed by China ($154 billion), which has increased its R&D investment by 10 percent each year for the past 10 years.
- China, South Korea, and Singapore are emerging world leaders in the development of university-related research parks and are increasing their investments in other forms of R&D infrastructure, while U.S. investments in such facilities remain flat or are declining.
- As Singapore’s Minister of Trade, Industry and Manpower recently noted, “With such vast market opportunities, it is little wonder that many Asian countries are developing biomedical manufacturing and R&D activities. In Singapore’s case, our plans for the development of a biomedical cluster began 10 years ago. Since then over S$5 billion have been invested. With excellent connectivity to key Asian markets [and] a stable and skilled workforce…Singapore has attracted leading global companies from the pharmaceutical and biomedical sciences to establish operations here.” (Biospectrum Asia Pacific Life Sciences Industry Awards, March 12, 2010, pg. 18)

Many of the countries examined are providing tax and other financial incentives – ranging from reduced corporate tax rates to R&D tax credits – to attract and spur private investment in R&D.

- Although it was the first country to create an R&D tax credit, the U.S. now ranks 17th among OECD countries in terms of the level of its R&D tax credit. Of the 18 countries examined, 16 offer some type of R&D tax incentive, many of which are refundable and designed to help smaller firms grow. As Australia’s Innovation Minister, Senator Kim Carr, notes, “The R&D Tax Credit will serve as a beacon to attract more firms, particularly small and medium firms, to undertake research and development in Australia.” (August 24, 2011, pg. 30)
- U.S. competitors are also implementing increasingly globally competitive corporate tax rates. For example, Ireland’s corporate tax rate of 12.5 percent is among the world’s lowest, while the U.S. now has the world’s highest corporate tax rate.
Countries are competing for talent as aggressively as they compete for industry locations and R&D activities, as many have implemented policies designed to attract, develop, and retain talent.

- While many of the countries examined are increasing their commitment to fostering science, technology, engineering, and mathematics (STEM) skills and improving their STEM rankings, Battelle reports that the U.S. continues to fall behind in key STEM education indicators.
- U.S. students currently rank 23rd among OECD countries on the science portion of the Programme for International Student Assessment, 31st on the math portion, and last in terms of science-related graduates between 25 and 34 years old. China, Singapore, Japan, and South Korea rank among the top countries in these indicators.
- Other countries are ramping up their efforts to grow their indigenous workforce by implementing policies to build their STEM talent pool and adopting innovative talent attraction and talent development programs. One example is China’s Thousand Talents Program, which is designed to incentivize expatriates in science and engineering fields to return to China for well-funded, prestigious positions.

The report found that the U.S. is the world leader in biopharmaceutical venture capital funding, but that emerging nations have made significant gains in establishing a venture capital market over the past decade.

- While the U.S. share of worldwide biopharmaceutical venture capital funding was over 80 percent in 2011, many venture capital professionals recently surveyed said they expect decreases in future investments in biopharmaceuticals.
- Unlike the U.S., nearly all of the countries examined provide public support to innovative, technology-based companies, through direct equity investments.
- As Battelle found, “the U.S. continues to have the advantage of the most established capital markets and entrepreneurial development infrastructure; however, emerging nations are laying the foundation of an infrastructure for venture-backed new biopharmaceutical companies, with significant gains made in establishing a venture capital market over the past decade.”

The report concludes that while the U.S. is the current leader in biopharmaceutical R&D and innovation, “it should be recognized that international competition is rising and retaining U.S. leadership will require the U.S. to not only maintain but expand investments in R&D and commercialization, education and workforce development, financial capital, and the nation’s science and technology infrastructure, as well as consider the overall favorability of the environment for innovation in the U.S.” The examination of policies and programs being pursued by other countries reveals striking similarities, and the findings “suggest potential initiatives that might be explored in the U.S. to sustain and grow its biopharmaceutical industry.”
Select Country Profiles

Singapore: Singapore’s government has committed to fostering the growth of its innovative biopharmaceutical sector and the nation’s overall R&D infrastructure. To achieve this, the country has invested heavily in R&D, undertaken significant workforce development initiatives, engaged industry leaders in technology development, and provided support to emerging companies seeking to commercialize new biomedical discoveries. Singapore has also sought to attract the R&D operations of biopharmaceutical firms through creation of the Biopolis Research Park, which houses the country’s many bioscience research institutions. These efforts have resulted in significant improvements in a number of key innovation indicators:

- Singapore’s biopharmaceutical sector contributed nearly $6.5 billion to the country’s GDP in 2010, a growth of 274 percent since 2000.
- Singapore’s biopharmaceutical sector employed more than 13,000 in 2010.
- Biopharmaceutical sector exports have also grown significantly since 2000, increasing 503 percent over the ten-year period.
- Singapore has achieved its goal of increasing R&D expenditures as percentage of GDP to 2.5 percent, with a new goal of increasing R&D spending to 3.5 percent of GDP by 2015.
- Singapore has the highest concentration of researchers employed in R&D, with 6,088 researchers per million population.

Ireland: Despite being hit hard by the recent global recession, Ireland continues to build its biotechnology R&D base in an effort to attract the R&D operations of multinational biopharmaceutical companies inside its borders. The government has been providing substantial support for R&D activities, encouraging collaboration between companies and research institutions, and offering incentives to attract talent and foreign direct investment in R&D operations. Key elements of Ireland’s strategy to attract foreign direct investment include:

- Heavy public investment in building a robust R&D infrastructure including research parks and bioincubators;
- A low corporate tax rate of 12.5 percent – one of the world’s lowest – which the country has maintained even in the current financial crisis;
- An R&D tax credit that was recently boosted from 20 percent to 25 percent, in addition to a 12.5 percent deduction for R&D expenditures conducted in Ireland.

South Africa: While South Africa currently has a less robust biopharmaceutical sector, the government has developed a detailed strategy to help it become one of the top three emerging economies in the global biopharmaceutical industry, based on an expansive innovation system leveraging the country’s strengths. With the goal of moving its economy from “Farmer to Pharma,” South Africa’s initial focus is to build its R&D infrastructure and expertise:

- South Africa has plans to create and fund five theme-specific consortium-based centers of competence that focus on the five top national health priorities, linked to the growth of the domestic biopharmaceutical sector.
- South Africa has created a publicly-funded venture capital fund to assist start-ups.
- South Africa is building international collaborations and providing matching funds to encourage such collaborations.