

SCIENTIFIC
AMERICAN

worldVIEW

A GLOBAL BIOTECHNOLOGY PERSPECTIVE

SEARCHING FOR THE NEXT WAVE

SPECIAL REPORT

RIPPLES OF INNOVATION
FROM UNEXPECTED PLACES



+

THE 4TH
ANNUAL
WORLDVIEW
SCORECARD
NATIONS GO FOR THE
BIOTECH GOLD

MARATHON MEN:
3 ENDURING LIFE
SCIENCE LEADERS

DROWNING IN DATA?
FLOOD CONTROL
FOR THE FUTURE



COVER ILLUSTRATION BY JUSTIN GABBARD

CONTENTS

WORLDVIEW 2012

2 Searching for Hot Spots in Cool Economic Times

BY YALI FRIEDMAN & MIKE MAY

3 yourVIEWS:
Letters, Opinions, Critiques

SPECIAL REPORT: SEARCHING FOR THE NEXT WAVE

8 Biotech Without Borders

Emerging nations throughout the world are formulating and executing policies for biotechnology development. What issues will influence their chances of success? BY PETER GWYNNE

10 Africa's Red Biotechnology

Only investment and risk will boost medical R&D

BY ELIE DOLGIN

12 White Lightning

Nature and novelty spark marketable approaches to industrial biotech

BY TED AGRES

14 A Modern Green Revolution

Emerging areas need genetically modified crops developed by and for them

BY EMILY WALTZ

16 Building Bigger Blue Markets

From food to fuel, innovation through aquaculture is making a splash BY KARYN HEDE

18 Rebooting the System

Homegrown software yields public-health breakthroughs in Nicaragua BY BILL CANNON

22 WORLDVIEW SCORECARD

The fourth annual global biotechnology survey

WORLDVIEW PROFILES

54 Triple A-Rated: 3 Biotech Trailblazers

Lee Hood, Richard Pops & Terry McGuire

BY RICHARD GALLAGHER

66 COUNTRY SPOTLIGHTS

Canada, Chile, Cuba, France, Germany, Kenya, Qatar, India/Russia, Thailand, United States

DATA DRILL DOWN

80 Navigating the New Normal

Framing the critical strategic choices for life science firms today

BY EAMONN KELLY, GEORGE BAEDER & STEVE WEBER

82 Tweeting for Technology

Biotechnology and pharmaceutical companies use social media for advertising and more BY MIKE MAY

85 Does Your Country Deserve Investment from Biopharma?

An ongoing survey of executives and a resulting country index will reveal who is ready to compete for capital

BY MEIR PEREZ PUGATCH, RACHEL CHU, DAVID TORSTENSSON & AMIR DAYAN

88 Moore's Law is Remaking Medicine

Rapidly expanding access to data and interactive communication promises on-the-spot personalized diagnosis and treatment

BY ROBERT GOLDBERG

90 Calculating *E. coli* Contamination

Multiplexing and bioinformatics deliver a rapid test that meets the USDA's new standards

BY MIKE MAY



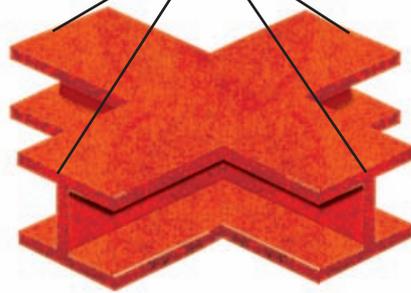
DOES YOUR COUNTRY DESERVE INVESTMENT FROM BIOPHARMA?

An ongoing survey of executives and a resulting country index will reveal who is ready to compete for capital

BY MEIR PEREZ PUGATCH,
RACHEL CHU, DAVID TORSTENSSON
& AMIR DAYAN

Local biopharmaceutical executives enjoy an intimate view of a country's prospects for market access, the regulatory environment and manufacturing and supply chains. Do these experts consider their country's current conditions worthy of expanding employment or new investment in research, development or manufacturing? This question forms the basis of our Biopharmaceutical Competitiveness and Investment Survey (BCI), which is a new tool for evaluating the biomedical sector in a given country or region. In essence, the BCI polls key decision-makers—local biopharmaceutical executives—and asks if they would encourage investment in their country when talking with senior company executives, who must allocate capital, technology and resources across dozens of countries. In an industry investing more than \$100 billion globally per year, the concerns of these executives represent valuable insights for governments competing for a larger share of this massive investment flow.

The BCI Survey asks executives and experts operating “on the ground” a wide range of in-depth questions about the performance of the country in which they operate. Their answers are then statistically analyzed to produce a quantitative index of that country's competitiveness in various areas of the biomedical-innovation pipeline. By drawing on firsthand insight from locally stationed biopharmaceutical executives, the BCI's survey-based approach represents a unique and innovative method for evaluating the biomedical-investment attractiveness of countries.



Although this survey arises from the subjective views of individuals, an expert's perspective and experiences often influence investment decisions. The BCI captures this element by gathering a large sample of respondents for each country and using statistical analysis to translate responses into concrete measurements. Ultimately, a country's BCI score might provide an intelligence tool to help policymakers better understand larger trends in their country's biomedical sector. The BCI score also complements other indices and measurements of national performance, including the *Scientific American Worldview Scorecard*, allowing a more comprehensive understanding of where improvements are needed.

A BOTTOM-UP APPROACH

Most global indices create a numerical variable based on the combined sum of other variables that are assumed to reflect an underlying construct. These so-called composite indices often rely on a "top-down" approach, in which the creator determines the best practice or standard, and then evaluates performance against this standard and assigns an overall score. In contrast, the BCI survey—a "bottom-up" approach—measures a country's performance and compares it to that of other regions. In general, a survey asks experts and professionals about their specific views on and experiences with the subject matter or situation under analysis. Surveys of business executives are often used to gauge economic and commercial activities. One of the first notable studies of this type surveyed 100 companies in six manufacturing industries on decisions concerning foreign direct investment (Lee, J.-Y., & Mansfield, E. Intellectual property protection and U.S. foreign direct investment. *Review of*

Economics and Statistics 78(2):181–186 (1996)). More recent examples include the 2010 survey of executives by the European Patent Office and several partners, which measured the licensing of environmentally sensitive technologies in developed and developing countries (Patents and Clean Energy: Bridging the Gap Between Evidence and Policy, 2010. http://ictsd.org/downloads/2010/09/study-patents-and-clean-energy_15910.pdf).

Existing survey-based studies, however, often fail to apply a quantitative measurement to the views of respondents. The BCI fills this gap by asking respondents how a given nation measures up with respect to different factors that combine to form an optimal environment for biopharmaceutical commercial development. Statistical analysis of the survey data allows each country to be scored and ranked using numerical variables.

The survey examines the entire "ecosystem" in which biomedical innovation takes place by asking seven questions in each of seven major categories:

- scientific capabilities and infrastructure
- clinical environment (from test tube to patient)
- manufacturing and logistics
- regulatory framework
- healthcare financing
- effective market-access activities
- overall market conditions.

For each question, respondents rate a country's performance in relation to a certain benchmark. Figure 1 gives examples of the benchmarks used in two survey questions. In question 9, a high level of commitment to clinical research by hospitals across the country provides the benchmark. For Question 30, a structured and balanced process for negotiating prices of products with payers and health-care authorities serves as the standard.

In order to capture specific nuances of country performance, respondents receive a scale of four answers for each question. This scale ranges from the lowest possible performance to the highest possible performance (i.e., the benchmark), but the exact scale varies for each question. This design gives respondents a framework for gauging their views, but in a way that minimizes constraining their answers. Moreover, the BCI covers a wide sample of countries—over 60 developed and emerging economies—and arises from the collective responses of 15–20 biopharmaceutical executives operating in each country.

To score the responses, each question accounts for a total of two points, which means that a maximum score of 14 exists for each category. We give the final category, a single question that captures a respondent's overall impression of country performance, a maximum score of 2.

The four answer options correspond to scores of 0.5, 1.0, 1.5 and 2.0—ranging, in order, from the options reflecting the poorest to the highest performance. Based

FIGURE 1. PERFORMANCE BENCHMARKS.

QUESTION 9

How important are clinical trials to hospitals in your country in terms of their commitment to encouraging and participating in cutting-edge research?

- » Of little importance (interest limited to a few clinicians)
- » Of limited importance (mostly in certain departments and hospitals)
- » Important (significant emphasis is placed on the ability to conduct clinical trials)
- » One of the top priorities (identified as a strategic objective)

QUESTION 30

To what extent is your organization able to effectively negotiate the prices of your products vis-à-vis public healthcare providers?

- » Virtually impossible (providers/payers have all the negotiating power)
- » To a limited extent (only in cases in which the product is very strong)
- » To a reasonable extent (providers take our negotiating needs into account but they have the final say)
- » To a great extent (there is a built-in process allowing both sides to negotiate on an equal footing)

on the analysis of all 50 responses, each country receives a score for each category as well as a total score, out of a maximum of 100.

REVIEWING PRELIMINARY RESULTS

In March and April 2012, we conducted a pilot study of the BCI, in which more than 250 executives from over 50 countries responded. The preliminary results of 11 countries, which reflect a wide range of developed and emerging economies, offer a glimpse into executives' views about how these countries can compete in the biopharmaceutical sector. Even these preliminary results reveal that certain countries seem to perform better than others.

The overall scores give an idea of the performance and relative competitiveness of the preliminary sample of countries. Generally speaking, countries with a score above 80 enjoy quite a competitive position relative to other countries, countries with scores of 70–80 possess reasonable competitiveness, scores of 60–70 indicate a limited ability to compete and those scoring 50–60 struggle.

The results by category provide a more “drilled-down” impression of executives' views of the performance of their country in the seven categories. As the detailed scores show, countries perform well in some areas but lag in others. For example, almost all countries—even countries with exceptional performance in most areas—performed the lowest in healthcare financing. Countries with the lowest overall scores also experience problems with additional areas, including scientific capabilities, manufacturing and logistics, and effective market-access activities. This table includes color-coded indicators of a country's performance compared to others.

Interestingly, the BCI results generally correspond with the 2011 *Scientific American Worldview* scores for these countries. For example, the countries with high scores in the 2011 *Worldview* Scorecard tended to be in the top of the BCI rankings. However, there are some clear outliers. For instance, India and Argentina ranked higher in the BCI index than in the *Worldview* Scorecard. Conversely, the United States ranks lower in the BCI index than in the *Worldview* Scorecard, which might be explained by recent developments in healthcare financing as well as the patenting of biotechnology-related inventions. The variations between metrics might arise, in part, from the individual biases of the respondents in the BCI index. Furthermore, the standard for attracting investment in a country's biotechnology industry depends on many factors, including the starting point of the country in question, individual views on which factors most affect a country's growth potential and areas of expertise.

In fact, the differences between the BCI index and the *Worldview* Scorecard emphasize the value of multiple approaches to assessing innovation in biotechnology. In particular, the views, experience and expertise of the executives provided in the BCI make it a powerful complement to a more formal and objective analysis of competitiveness around the world.

As we collect an even wider data set, the BCI index will provide an increasingly precise understanding of each country's performance. The full analysis of the 50 countries will be presented later this year. In addition, it would also be valuable to include an open-ended questionnaire in future iterations of the BCI in order to gauge respondents' views more specifically.

If you wish to participate in the BCI Survey, please contact Rachel Chu, rachelc@pugatch-consilium.com.

PRELIMINARY RESULTS BY CATEGORY

where colors indicate failing (■), similar (■) or attractive (■) relative to other countries in a specific category.

- STRONGLY COMPETITIVE
- ◆ REASONABLY COMPETITIVE
- LIMITED ABILITY TO COMPETE
- STRUGGLING TO COMPETE

	SCIENTIFIC CAPABILITIES & INFRASTRUCTURE	CLINICAL ENVIRONMENT	MANUFACTURING & LOGISTICS	REGULATORY FRAMEWORK	HEALTHCARE FINANCING	EFFECTIVE MARKET-ACCESS ACTIVITIES	OVERALL-MARKET CONDITIONS	GENERAL IMPRESSION	OVERALL SCORE
DENMARK	11.58	11.92	13.75	12.83	9.42	11.42	10.58	1.67	83.20
SWITZERLAND	11.14	9.36	12.21	11.79	8.29	11.14	12.07	1.57	77.57
SWEDEN	10.83	10.50	11.17	11.83	9.00	9.50	10.33	1.67	74.83
UNITED STATES	11.30	9.90	10.50	9.80	8.90	9.90	10.00	1.90	72.20
NORWAY	8.90	9.60	11.90	10.55	8.75	9.25	11.00	1.40	71.35
ISRAEL	10.15	10.73	11.19	9.08	8.50	8.85	9.92	1.54	69.96
INDIA	8.10	10.20	11.40	9.30	6.40	9.40	10.70	1.80	67.30
ARGENTINA	8.43	9.71	9.14	9.21	8.43	9.36	10.86	1.50	66.60
GREECE	7.36	9.54	9.57	9.18	7.50	9.64	8.57	1.39	62.75
RUSSIAN FEDERATION	8.29	9.71	7.86	7.64	7.43	7.86	9.43	1.50	59.71
TURKEY	5.58	8.96	9.46	7.83	6.00	7.21	8.54	1.38	54.96