

GLOBAL PATTERNS OF INNOVATION IN 2013

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This article examines global patterns of innovation as measured by receipt of issued US patents based on an annual listing of the recipients of that year's issued patents published by the USPTO. The US remains the top innovator in the corporate, governmental, and academic sectors. However, second place goes not to the established economies of Europe, but to those of Asia. The leading Asian patenting countries—Japan, South Korea, Taiwan, and China—together receive almost three times as many patents as the total received by the four leading European countries—Germany, France, the UK, and Italy. Innovation is highly concentrated; fewer than 800 organizations received 40 or more US patents in 2013 and accounted for 62.3% of all innovation. Sixty-six of the top 101 universities receiving US patents were in the US, receiving 4,248 patents or 73% of the patents issued to universities. The leading US universities receiving patents were the University of California System, MIT, and Stanford. Only 10 countries had universities on the list, with six in Asia, two in the Middle East, one in Europe, and one in North America. Another group of important inventing and patenting organizations consists of government laboratories and nonprofit research institutes. Thirty-four organizations received a total of 4,227 US patents, which is 80% of the number of patents received by three times as many universities. The government laboratory/nonprofit research institute list is led by two leading Asian nonprofit research institutes—ETRI in South Korea and ITRI in Taiwan.

Key words: Innovation; Regional; Patterns; US patents; Companies; Universities; National laboratories; Nonprofit research institutes

BACKGROUND

Each year, the United States Patent and Trademark Office (USPTO) issues a report titled *Patenting by Organizations (Utility Patents)* (9).

The report analyzes the US utility patents issued in that year and contains a wealth of interesting information on the current state of global innovation and also provides clues as to future trends. The report first gives overall

summary statistics for US patent issuances by organizations, governments, and individuals and then lists all organizations receiving 40 or more patents in that year. The National Academy of Inventors and the Intellectual Property Owners Association use the USPTO list to compile a list of the top patenting universities globally (6).

This article examines the 2013 reports. US-issued patents are a good proxy for global innovation because the US economy is the biggest in the world, and the US is where foreign inventors normally file their second patent applications after first applying in their home countries.

PATENTING BY COUNTRY

The USPTO issued 277,835 patents in 2013. By contrast, the European Patent Office (EPO) only issued 66,700 European patents (2). (In Europe, applicants then have to validate in whichever of the 38 member states of the EPO where they wish to secure protection.) The Japan Patent Office registered 277,079 patents in 2013, almost the same number as the USPTO (3).

DOMICILE OF RECIPIENTS OF US PATENTS

First, the report shows where the owners of issued US patents are domiciled. As shown in Table 1, just under half of the 277,835 US patents that were issued in 2013 were granted to entities domiciled in the US, and slightly over half were issued to entities in all other

countries of the world combined. By this measure, almost half of global innovation originates with US entities.

Of the foreign originating patents, 85% originated in just 10 countries, as shown in Table 2. The dominant role of the leading Asian countries—Japan, South Korea, Taiwan, and China—compared with the biggest European countries—Germany, France, the UK, and Italy—is striking. The four Asian countries together receive almost three times as many patents as the total received by the four European countries.

Table 3 shows the number of issued patents/million population. Taiwan receives the greatest number of US patents/million of population, at 473, followed by the US, Japan, and Israel. Each of these four countries receives over 10 times the global average of 38.9 patents per million population. Canada and Germany receive six times the global per capita average.

TYPES OF ORGANIZATIONS RECEIVING US PATENTS

The report then looks at the types of organizations that own the patents and divides them into corporations, government, and individuals, as shown in Table 4.

Table 1. Domicile of Recipients of US Patents in 2013

| Source | Number (%) |
|----------------|---------------|
| US origin | 133,593 (48%) |
| Foreign origin | 144,242 (52%) |
| Total | 277,835 |

Table 2. Country of Foreign Domicile of Recipients of US Patents in 2013

| Country | Number (%) |
|-------------|--------------|
| Japan | 51,919 (36%) |
| Germany | 15,498 (11%) |
| South Korea | 14,548 (10%) |
| Taiwan | 11,071 (8%) |
| Canada | 6,547 (5%) |
| France | 6,083 (4%) |
| China | 5,928 (4%) |
| UK | 5,806 (4%) |
| Israel | 3,012 (2%) |
| Italy | 2,499 (2%) |
| All other | 21,331 (15%) |
| Total | 144,242 |

Table 3. Issued US Patents/Million Population

| Country | US Patents | Population (Million)* | US Patents/ Million Population |
|-----------|------------|--------------------------|-----------------------------------|
| US | 133,593 | 316.2 | 422.5 |
| Japan | 51,919 | 127.3 | 407.8 |
| Germany | 14,388 | 80.6 | 178.5 |
| S. Korea | 14,548 | 50.2 | 289.8 |
| Taiwan | 11,071 | 23.4 | 473.1 |
| Canada | 6,547 | 35.3 | 185.5 |
| France | 6,083 | 63.9 | 95.2 |
| China | 5,928 | 1,357.4 | 4.4 |
| UK | 5,806 | 64.1 | 90.6 |
| Israel | 3,012 | 8.1 | 371.9 |
| Italy | 2,499 | 59.8 | 41.8 |
| All other | 22,441 | 4,950.7 | 4.5 |
| Total | 277,835 | 7,137.0 | 38.9 |

*Population Reference Bureau. Retrieved December 2015 from http://www.prb.org/pdf13/2013-population-data-sheet_eng.pdf

Corporations receive the largest number of issued US patents, followed by individuals. Until 1929, individuals received more patents than corporations; since then, more and more US patents have been issued to corporations. However, the individual count in 2013 may be somewhat understated since individual inventors frequently assign their patents to a company, either existing or newly established, which acquires the rights to the patent in order to develop the technology. In Chile, which is still an emerging country in terms of innovation, individuals still receive many more patents than corporations.

Part B of the Report lists the 789 organizations globally that received at least 40 issued US patents in 2013. The total number of US patents received by these 789 organizations

was 161,561, which was 62.3% of all the US patents issued in 2013.

UNIVERSITIES RECEIVING MOST US PATENTS

The USPTO does not further subdivide the types of corporations into for-profit and not-for-profit corporations. However, drawing from the USPTO data, the National Academy of Inventors (NAI) and the Intellectual Property Owners Association (IPO) have issued a report on the top 101 (101 because there was a tie for 100th place) universities receiving US patents in 2013, and this report provides further insights into patterns of global innovation. Given that academic research tends to be leading edge, the report perhaps provides a leading indicator of future trends in patterns of innovation.

In Table 5, the country where each institution is located has been added to the NAI/IPO report. These 101 universities received 5,816 US patents in 2013, which accounts for 2% of all issued US patents in 2013. The totals by country are shown in Table 6.

Sixty-six of the 101 universities were in the US, and they received 4,248 patents or 73% of all the patents issued to universities. [Data reported to the 2013 Annual Licensing Activity Survey of the Association of University Technology Managers (AUTM) shows that all US universities received 5,230 US patents in total; in other words, the 66 US institutions listed in Table 5 accounted for 81% of all US patents issued to universities in 2013.] This shows that US universities are more dominant within their peer group than US corporations, which received slightly less than 50% of all patents issued to corporations. The leading recipients of patents among US universities were the University of California System, MIT, and Stanford.

Only 10 countries had universities on the list, which is notable for being skewed even

Table 4. Types of Organizations Receiving US Patents in 2013

| Type of Organization | US | Foreign | Total | % |
|----------------------|---------|---------|---------|-------|
| Corporations | 124,753 | 133,196 | 257,949 | 92.8% |
| Government | 1,031 | 203 | 1,234 | 0.4% |
| Individuals | 13,320 | 5,332 | 18,652 | 6.7% |
| Total | 139,104 | 138,731 | 277,835 | |

Table 5. Top 101 Universities Receiving US Patents in 2013

| Rank/University | Country | No. of Patents |
|--|-----------|----------------|
| 1. University of California | US | 399 |
| 2. MIT | US | 281 |
| 3. Tsinghua University | China | 193 |
| 4. Stanford University | US | 170 |
| 5. University of Texas | US | 169 |
| 6. Wisconsin Alumni Research Foundation | US | 160 |
| 7. California Institute of Technology | US | 147 |
| 8. Columbia University | US | 104 |
| 9. Georgia Tech Research Corp | US | 98 |
| 10. University of Michigan | US | 97 |
| 11. University of Illinois | US | 96 |
| 12. National Taiwan University | Taiwan | 95 |
| 13. University of South Florida | US | 95 |
| 14. University of Florida | US | 93 |
| 15. National Tsing Hua University | Taiwan | 91 |
| 16. National Chiao Tung University | Taiwan | 89 |
| 17. University of Pennsylvania. | US | 87 |
| 18. University of Washington | US | 84 |
| 19. King Fahd University of Petroleum and Minerals | S. Arabia | 83 |
| 20. Johns Hopkins University | US | 82 |
| 20. University of Southern California | US | 82 |
| 22. Northwestern University | US | 78 |
| 23. Institute of Microelectronics, CAS | China | 75 |
| 24. Cornell University | US | 73 |
| 25. Ohio State University | US | 71 |
| 26. Harvard College | US | 69 |
| 27. Korea Advanced Institute of Science and Technology | S. Korea | 63 |
| 27. Purdue Research Foundation | US | 63 |
| 29. Mayo Foundation | US | 60 |
| 29. State University of New York | US | 60 |
| 31. University of Utah | US | 59 |
| 32. University of Massachusetts | US | 57 |
| 33. University of Minnesota | US | 55 |
| 33. University of Pittsburgh | US | 55 |
| 35. Ramot at Tel Aviv University Ltd. | Israel | 54 |
| 35. New York University | US | 54 |
| 37. Arizona State University | US | 53 |
| 38. University of Central Florida | US | 51 |
| 38. University of Maryland | US | 51 |
| 40. Academia Sinica | China | 50 |
| 40. University of North Carolina | US | 50 |
| 42. University of Tokyo | Japan | 48 |
| 43. Florida State University | US | 47 |
| 44. Duke University | US | 46 |
| 45. Seoul National University R&Db Foundation | S. Korea | 44 |
| 45. National Cheng Kung University | Taiwan | 44 |
| 47. Yeda Research and Development Co., Ltd. | Israel | 43 |

(continued)

Table 5. (Continued)

| Rank/University | Country | No. of Patents |
|--|-------------|----------------|
| 48. National Taiwan University of Science and Technology | Taiwan | 42 |
| 49. Pohang Univ. of Science and Technology | S. Korea | 41 |
| 50. Rutgers University | US | 39 |
| 50. University of Colorado | US | 39 |
| 50. University of Rochester | US | 39 |
| 53. National Central University | Taiwan | 38 |
| 53. Dartmouth College | US | 38 |
| 53. Vanderbilt University | US | 38 |
| 56. University of New Mexico | US | 36 |
| 57. Penn State Research Foundation, Inc. | US | 35 |
| 58. North Carolina State University | US | 34 |
| 58. Tufts University | US | 34 |
| 58. Washington University | US | 34 |
| 61. Carnegie-Mellon University | US | 33 |
| 61. University of Missouri | US | 33 |
| 63. Sungkyunkwan University Foundation | S. Korea | 32 |
| 63. Case Western Reserve University | US | 32 |
| 63. Rice University | US | 32 |
| 66. University of British Columbia | Canada | 31 |
| 67. Hong Kong Polytechnic University | Hong Kong | 30 |
| 68. Kyoto University | Japan | 29 |
| 68. Drexel University | US | 29 |
| 68. University of Arkansas | US | 29 |
| 68. University of South Carolina | US | 29 |
| 72. Ecole Polytechnique, Federale De Lausanne | Switzerland | 28 |
| 72. University of Akron | US | 28 |
| 74. The Hong Kong University of Science & Technology | Hong Kong | 27 |
| 74. Yissum, Hebrew University of Jerusalem | Israel | 27 |
| 74. Korea University Research and Business Foundation | S. Korea | 27 |
| 74. King Saud University | S. Arabia | 27 |
| 74. Indiana University | US | 27 |
| 74. Michigan State University | US | 27 |
| 80. University of Tennessee Research Foundation | US | 26 |
| 81. Osaka University | Japan | 25 |
| 81. Texas A&M University | US | 25 |
| 81. University of Medicine and Dentistry of New Jersey | US | 25 |
| 81. University of Virginia | US | 25 |
| 81. Peking University | China | 25 |
| 86. Emory University | US | 24 |
| 86. Iowa State University | US | 24 |
| 86. University of Kentucky | US | 24 |
| 89. Brigham Young University | US | 23 |
| 89. Yale University | US | 23 |
| 91. Chinese University of Hong Kong | Hong Kong | 22 |
| 91. Ben Gurion University of The Negev | Israel | 22 |
| 91. Tohoku University | Japan | 22 |
| 91. Yonsei University | S. Korea | 22 |

(continued)

Table 5. (Continued)

| Rank/University | Country | No. of Patents |
|--|----------|----------------|
| 91. Chung Yuan Christian University | Taiwan | 22 |
| 91. Princeton University | US | 22 |
| 97. Indian Institute of Science | India | 21 |
| 97. National Taipei University of Technology | Taiwan | 21 |
| 97. Auburn University | US | 21 |
| 100. Hanyang University | S. Korea | 20 |
| 100. Gwangju Institute of Science and Technology | S. Korea | 20 |
| Total | | 5,816 |

more toward Asia than was the list of top patenting countries in Table 2. Six of the 10 countries are in Asia, two in the Middle East, one in Europe, and one in North America. The university with the third highest number of patents, after the University of California System and MIT, was China’s Tsinghua University, which received more US patents than Stanford.

GOVERNMENT LABORATORIES AND NONPROFIT RESEARCH INSTITUTES RECEIVING MOST US PATENTS

Another group of important inventing and patenting organizations consists of government laboratories and nonprofit research institutes.

Although legally these are two very different kinds of entities, they perform similar work, and the structure they adopt is often based on history—government labs generally have a defined annual appropriated budget, while nonprofit research institutes have to compete for peer-reviewed grants to fund their activities. Some government labs are “GoGos”—government-owned, government-operated—while others are “GoCos”—government-owned, contractor-operated.

Table 7 shows the government labs and nonprofit research institutes that received at least 40 US patents in 2013. Thirty-four organizations received a total of 4,227 US patents, which is 80% of the number of patents received by three times as many universities, reflecting

Table 6. US Patents Received by Universities by Country

| Country | No. of Universities | Total US Patents | % of Total |
|--------------|---------------------|------------------|------------|
| US | 65 | 4,223 | 72.6% |
| Taiwan | 9 | 492 | 8.5% |
| South Korea | 8 | 269 | 4.6% |
| China | 3 | 293 | 5.0% |
| Israel | 4 | 146 | 2.5% |
| Japan | 4 | 124 | 2.1% |
| Saudi Arabia | 2 | 110 | 1.9% |
| Hong Kong | 3 | 79 | 1.4% |
| Canada | 1 | 31 | 0.5% |
| Switzerland | 1 | 28 | 0.5% |
| India | 1 | 21 | 0.4% |
| Total | 101 | 5,816 | |

Table 7. US Patents Received by Government Labs and Nonprofit Research Institutes

| Organization | Country | No. of Patents |
|------------------------------------|--------------|----------------|
| ETRI | S. Korea | 868 |
| ITRI | Taiwan | 485 |
| US Navy | US | 399 |
| CEA | France | 301 |
| Fraunhofer | Germany | 181 |
| US Army | US | 155 |
| US DHHS | US | 146 |
| CNRS | France | 117 |
| Sandia National Lab | US | 95 |
| US NASA | US | 92 |
| Imec Vz | Belgium | 88 |
| Lawrence Livermore Laboratory | US | 88 |
| UT-Battelle | US | 75 |
| NIAIST | Japan | 72 |
| JSTA | Japan | 66 |
| A-Star | Singapore | 66 |
| Mass General Hospital | US | 66 |
| KIST | S. Korea | 65 |
| Los Alamos Laboratory | US | 60 |
| Institute for Information Industry | Taiwan | 59 |
| US Air force | US | 58 |
| CSIRO | Australia | 55 |
| CSIR | India | 55 |
| Institute of Nuclear Energy Res. | Taiwan | 55 |
| USDA | US | 52 |
| Battelle | US | 50 |
| Cleveland Clinic | US | 50 |
| SRI | US | 50 |
| Southwest Research Institute | US | 48 |
| TNO | Holland | 43 |
| US DOE | US | 43 |
| INSERM | France | 42 |
| KACST | Saudi Arabia | 42 |
| Hong Kong ASTRI | Hong Kong | 40 |
| Total | | 4,227 |

the more applied research focus of such organizations as compared with universities.

The list is led by two leading Asian non-profit research institutes—Electronics and Telecommunications Institute (ETRI) in South Korea and Industrial Technology Research Institute (ITRI) in Taiwan—which have both played a major role in the emergence of global electronics industries in those two countries.

Table 8 shows the patents received by government labs and nonprofit research institutes by country. Again, almost half of the institutes are in the US, but the US receives only 36% of the patents issued to such organizations. Seven countries are in Asia (broadly defined to include Australia), four are in Europe, and one in the Middle East. Because of the number of patents received by ETRI and ITRI,

Table 8. US Patents Received by Government Labs and Nonprofit Research Institutes by Country

| Country | No. of Institutions | No. of Patents | % of Total |
|--------------|---------------------|----------------|------------|
| US | 16 | 1,527 | 36.1% |
| South Korea | 2 | 933 | 22.1% |
| Taiwan | 3 | 599 | 14.2% |
| France | 3 | 460 | 10.9% |
| Germany | 1 | 181 | 4.3% |
| Japan | 2 | 138 | 3.3% |
| Belgium | 1 | 88 | 2.1% |
| Singapore | 1 | 66 | 1.6% |
| Australia | 1 | 55 | 1.3% |
| India | 1 | 55 | 1.3% |
| Holland | 1 | 43 | 1.0% |
| Saudi Arabia | 1 | 42 | 1.0% |
| Hong Kong | 1 | 40 | 0.9% |
| Total | 34 | 4,227 | |

Asia’s share of the patents received by government labs and nonprofit research institutes is high.

DISCUSSION

This article looks at patterns of innovation as measured by one generally accepted proxy: patents. Equating innovation with patents is a considerable oversimplification, and the actual relationship is more complex. For instance, a commonly cited figure is that 95% of patents are not practiced. In the case of universities, data from the AUTM annual licensing activity surveys since 1997 show that US universities have received 315,415 invention disclosures, filed 275,923 patent applications on them, licensed 88,256 of them, and their licensees have launched 9,946 products based on these technologies (1). Therefore, 32% of university patent applications were licensed, but only 3.6% resulted in actual products. However, patenting and technology transfer activities provide additional benefits to universities beyond the commercialization of products, such as faculty and student recruitment and

increased prestige (5), and patents received by university faculty are increasingly used as a metric for tenure and promotion (7,8).

Mandel reviews the literature on the relationship between patents and innovation in detail (4). It is also fair to say that although patents do not necessarily result in innovation, they demonstrate an intent to innovate and that the absence of patents—in a company, a country, or a region—probably indicates an absence or, at the very least, a reduced drive to innovate compared with companies, countries, or regions that show a high level of patenting activity.

Another limitation of this article is that it looks at a single year and so does not capture the dynamics of the patterns of patenting behavior. It is the author’s intent to repeat the analysis on a triennial basis to see whether the patterns of patenting are changing.

Subject to these caveats, the data show that the US still has a leading role in innovation, receiving almost as many US patents as the rest of the world combined. However, the data also show the increasing role of Asia, which has eclipsed Europe in innovation as measured by patenting activity.

Public sector research results in a significant proportion of overall innovation. Universities, government labs, and nonprofit research institutes account for over 5% of all US patents, and, in the public sector, the US is even more dominant than in the corporate sector. In the university sector, US universities receive 73% of all patents issued to universities, with Asian universities being the next most prolific with 22%, the Middle East with 4%, and Europe with less than 1%. In the government lab/nonprofit research institute sector, the US receives around one third of issued patents, while Asian countries receive 46%, European countries receive 18%, and the Middle East receives 1%.

In the Middle East, Israel has always had a prominent role in innovation—not for nothing

was a recent book about innovation in Israel titled *Start-Up Nation*. What is more surprising is the effort being made by Saudi Arabia. It has two universities—King Fahd University of Petroleum and Minerals and King Saud University—in the top 101 universities list, plus it has a national laboratory, King Abdulaziz City for Science and Technology (KACST), on the list of government labs/nonprofit research institutes. Some of the patents assigned to the latter may result from the role of KACST in funding research carried out at other Saudi institutions; the terms of this funding generally requires that any resultant patents be assigned or, at a minimum, coassigned, to KACST, much in the way that the US government owned patents that resulted from federal funding of university research prior to the passage of Bayh-Dole.

CONCLUSIONS

Public sector research often leads to major breakthroughs with considerable long-term impact. These breakthroughs tend to be commercialized in the same country as the inventing institution, so this data would seem to indicate that the trends identified in the overall patent landscape—US leadership and US and Asian dominance over Europe—will continue for the foreseeable future. We will report in due course on the 2016 USPTO and NAI-IPOA reports to determine whether these predictions are borne out.

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