Global Trends in Patenting

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Abstract

The United States' historical dominance in the issuance of patents is being threatened. In the United States, a patent for an invention is the grant of a property right to the inventor, issued by the U.S. Patent and Trademark Office. Patents for inventions filed in the world's three largest markets, the United States, European Union, and Japan, are the most valued. These triple-filed patents are called triadic patent families. This paper uses data from the National Science Foundation's Division of Science Resources Statistics (SRS), developed under the guidance of the National Science Board, to present global trends in patenting. These trends indicate that U.S. innovativeness and technological development is not keeping pace with the rest of the world. Strategies to combat this are explored in a second paper.

Introduction

The U.S. Patent and Trademark Office (USPTO) defines a patent for an invention as the grant of a property right to the inventor, issued by the USPTO. The term of a new patent is usually 20 years from the date on which the application for the patent was filed. U.S. patent grants are effective only within the United States, its territories, and possessions. A patent grants the right to exclude others from making, using, offering for sale, selling, and/or importing the invention. Once a patent is issued, the individual receiving the patent must enforce it without help from the USPTO. Three types of patents exist:

1. Utility patents, which are granted to inventors or discoverers of any new and useful process, machine, article of manufacture, composition of matter, or any new and useful improvement to these that already exist.
2. Design patents, which are granted to inventors of new, original, and ornamental design for an article of manufacture.
3. Plant patents, which are granted to inventors or discoverers of, or those who asexually reproduce, distinct and new varieties of plants [1].

It is a long-held, worldwide belief that patents are an indicator of a country's innovativeness. Innovation is defined as the introduction of new things or methods [2]. If these inventions improve products, processes, or services for the public, then they transform into innovations. An innovation can be big or small, completely new or slightly different, complex or simple, and/or a technical achievement or design [3]. Patented inventions have great economic importance when they result in new or improved products or processes, entirely new industries, and when their licensing provides an important source of revenue. Worldwide revenues from patent licensing increased from $15 billion in 1990 to $110 billion in 2000 [4].

At its July 2007 Patent Colloquium on National Innovation Strategies, the World Intellectual Property Organization (WIPO) stated that "national intellectual property (IP) systems and, in particular, the patent system, are widely recognized as a tool for boosting innovation, and thus technological development" [5]. Recognizing this relationship between patents, innovation, and technological development is important to understanding the data presentation in later sections. WIPO, which was established in 1967, is an agency of the United Nations. It is dedicated to developing a balanced and accessible IP system that rewards creativity, stimulates innovation, and contributes to economic development while safeguarding the public interest [6].

The Innovation Alliance, an organization committed to improving patent quality while protecting and promoting innovation, developed a patent-based business model. In this model, patents lead to funding, funding leads to research, and research leads to innovation. Figure 1 illustrates this model [7].

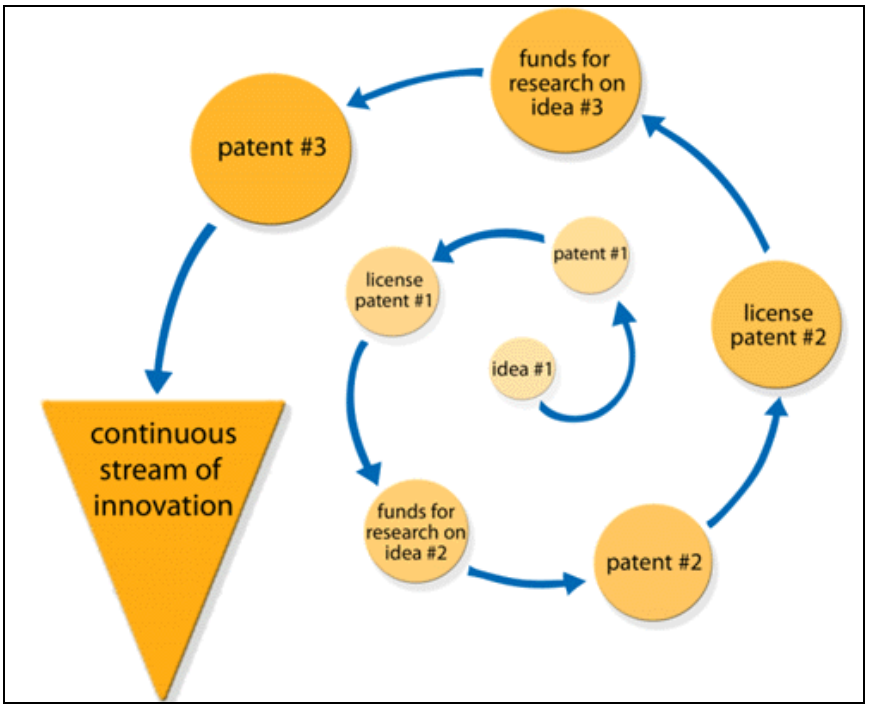

Figure 1: Patents Lead to Innovation [7]

Papers exist detailing objective and data-driven linkages between patents and innovation. For example, Lerner [8] stated that economists have long believed the patent system to be an important element for policymakers to affect the speed and nature of innovation in a country's economy. He cited data-driven studies linking patents to innovation. Gambardella, Harhoff, and Verspagen [9] performed data collection and analysis to conclude that patent value is significantly correlated with indirect indicators of innovation quality. They also cited several references to published papers having studies that confirm patents are an indication of innovation [9].

Australia has a policy linking patents to innovation. It introduced an innovation patent in 2001. It protects inventions not meeting the inventive threshold required for standard patents. It is meant to stimulate innovation among small to medium-sized businesses and industries, and it is a relatively quick way to obtain protection for new devices, substances, methods, or processes. The owner of any new and useful invention that involves an innovative step can apply for an innovation patent [10].

RealInnovation.com [11] stated a patent is a step on the way to innovation. Preceding innovation, the patent announces a new development and keeps organizations and individuals pursuing new and unique competitive advantages. Patents measure only one aspect of the innovation process—the development and property grant of an invention. An invention may lead to an innovation, but it is not the sole requirement or measure of an innovation [11].

This is just a small sampling of the available evidence that the issuance of patents is an indication of a country's innovativeness. Therefore, as data on global trends in patenting, as well as patent-related economic growth and development, are presented in the following sections, it should be kept in mind that these are also global trends in innovativeness.

U.S. Position in the Global Marketplace

Data and information found in the publication, *Science and Engineering Indicators 2008, Volume I,* from the National Science Board in Arlington, Virginia, provided key points regarding the United States and its current standing in the international marketplace for technology products, services, and development [12]. As mentioned earlier, technological development results from innovation, which results from patents. A threatened world leadership in technology indicates that the same is occurring in innovation and patents. The United States, with the largest economy of any nation, has long been a leader in technology products and services. However, the increasing competition from the European Union (EU), Japan, and the emerging economies of China and India are threatening the U.S. leadership position. The following statements are found in the "Highlights" section of *Science and Engineering Indicators 2008.*

"The United States has a leading position in the market-oriented knowledge-intensive service industries that are key contributors to economic growth around the world.

- Market-oriented knowledge-intensive services—business, financial, and communications—are driving growth in the service sector, which now accounts for nearly 70 percent of global economic activity. Market-oriented knowledge-intensive

services generated $12 trillion in gross revenues (sales) in 2005 and grew twice as fast as other services between 1986 and 2005.

- The United States is the leading provider of market-oriented knowledge-intensive services, responsible for about 40 percent of world revenues on a value-added basis (gross revenue sales minus the purchase of domestic and imported supplies and inputs from other industries) over the past decade. The U.S. world share of value-added exceeds the world share of both the EU and Asia in all three industries.
- Asia, ranked third compared with the United States and the EU, has shown a steady rise in its world value-added share over the past two decades. China and India are leading Asia's increase, primarily in communications" [12].

"High-technology manufacturing industries are key contributors to global manufacturing sector growth.

- Over the past 20 years, the rate of growth in the world gross revenue in high-technology manufacturing industries was double that of other manufacturing industries. Asia has the largest high-technology manufacturing industry sector, followed by the United States and the EU, which ranks a distant third.
- The United States has the single largest value-added world share (35 percent in 2005) of any country in high-technology manufacturing industries. It is ranked first in three of the five high-technology industries (scientific instruments, aerospace, and pharmaceuticals) and is ranked second on the other two (communications equipment and office machinery and computers).
- China has made remarkable progress. Its world share of high-technology manufacturing value-added has more than quadrupled during the past decade. Estimates for 2005 show China accounting for 16 percent of world value-added, making it the third-ranked country globally, just short of Japan, whose world share in these industries fell sharply from 30 percent in 1989 to an estimated 16 percent in 2005.
- U.S. manufacturing has become more technology intensive, with the high-technology share of manufacturing industries increasing from 14 percent in 1990 to 24 percent in 2005. The high-technology share of China and India's manufacturing industries has also increased, suggesting that manufacturing output in lower-wage countries is also shifting toward technology-intensive goods" [12].

U.S. Trade Balance in High-Tech Goods and High-Tech Manufacturing

Regarding the U.S. trade balance, "the U.S. World market share of exports by high-technology manufacturing industries and advanced products has declined.

- The U.S. world market share of exports by high-technology industries dropped from about 20 percent in the early 1990s to 12 percent in 2005, primarily because of losses in export share by U.S. industries producing communications equipment, office machinery, and computers.
- The trend for China has been quite different. China's share has grown rapidly. Its world market share of high-technology industry exports has more than doubled from 8 percent in 1999 to an estimated 19 percent in 2005. Exports by China's high-technology industries surpassed those of Japan in 2001, the EU (excluding intra-EU

exports) in 2002, and the United States in 2003. China has become the highest ranked high-technology exporter of the six largest developing economies according to its composite score in 2007. The others are India, Russia, Mexico, Brazil, and Indonesia. China was ranked fourth a decade ago, moved to second in 1999, and then moved to first in 2002. The previous leader was India. Russia's ranking has fluctuated over the last decade. Mexico improved its position compared with past cycles. Brazil continued a decade-long decline in its ranking.

- The reduction of U.S. industry's world export share has coincided with the decline in the U.S. trade balance in high-technology manufacturing industries that began in the late 1990s.
- The historically strong U.S. trade balance in advanced technology products exhibited a similar reduction, shifting from surplus to deficit starting in 2002. Figure 2 illustrates this. The overall U.S. trade deficit is largely driven by U.S. trade with Asian countries, especially China and Malaysia" [12].

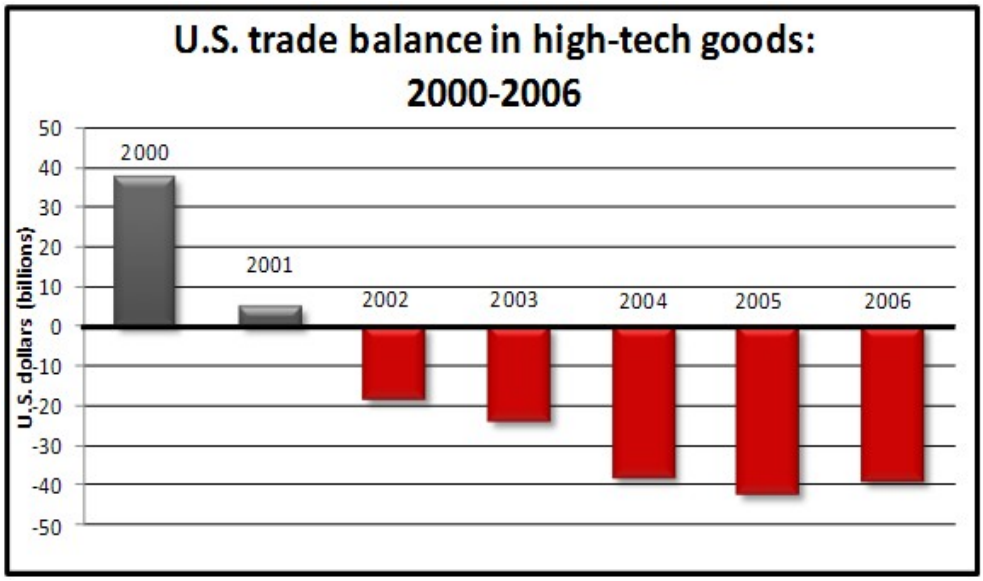

Figure 2: U.S. Trade Balance in High-Tech Goods, 2000–2006 [12]

It should be noted that, in contrast to the consistent deficits recorded by other U.S. manufacturing industries, U.S. high-technology industries consistently exported more than they imported throughout the 1980s to early 1990s.

Imports of high-technology manufacturing industries grew almost twice as fast as exports during the last decade (see Figure 3). In 2000, the deficit was $32 billion in constant dollars, which is equivalent to 4 percent of gross revenues of U.S. high-technology manufacturing industries. In 2005, the deficit increased to $135 billion, amounting to 14 percent of gross revenue. The two industries driving the U.S. high-technology industry trade deficit are communications equipment and office machinery and computing [12].

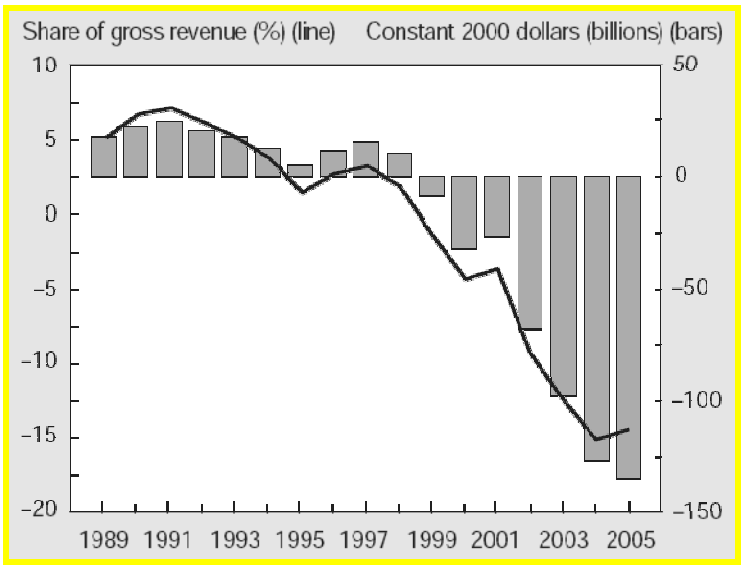

Figure 3: U.S. Trade Balance and Share of Gross Revenue for U.S. High-Technology Manufacturing Industries, 1989-2005 [12]

Real per Capita Income Growth

Productivity and per capita income growth of China and India have been much more rapid in recent years than that of the United States and other advanced economies. "Comparative real per capita GDP growth rates by country for the ten years from 1995 to 2005" [12] is graphically presented in Figure 4. The U.S. percent growth is below many other countries. Some of this may be explained by the fact that some of the countries began the measurement period with a proportionally lower GDP. Nonetheless, the United States is facing new challenges from many of the countries listed [12].

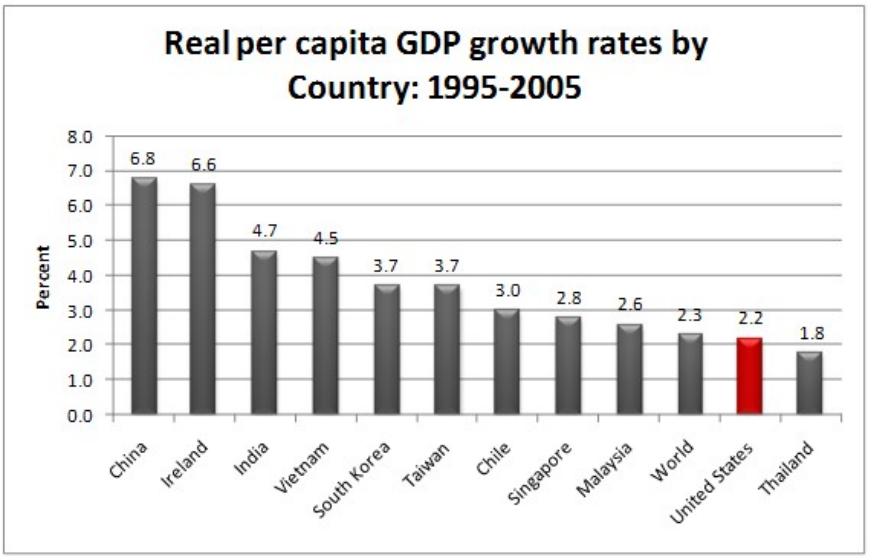

Figure 4: Real Per Capita GDP Growth Rates by Country, 1995–2005 [12]

Economic growth in China and India has been rapid in recent years, and these two countries have increased their global market share, trade, and investment in many industries. Productivity and per capita income growth of these two countries, particularly China, appear to have been much more rapid in recent years than that of the United States and other advanced economies [12].

U.S. and Global Trends in Patenting

The National Science Board [12] provided patent activity data that correlates with the previously presented data on the United States and its position in the global marketplace, its trade balance in high-tech goods and high-tech manufacturing, and its real per capita income growth. "The United States continues to be the leading source of newly patented inventions compared with the EU and Asia. Asia's patenting activity is growing rapidly, especially in Japan, South Korea, and Taiwan.

- Inventors residing in the United States accounted for 53 percent of U.S. patent applications in 2005. Asia, the second-ranked source of U.S. patent applications, more than doubled its share from two decades ago to 29 percent in 2005. This was due to growth from Japan, South Korea, and Taiwan. U.S. patent applications from China and India are also growing, although from a low level.
- U.S. inventors are also the leading source of economically valuable patents known as triadic patents. Triadic patents include only those inventions for which patent protection is sought in all three major world markets: the United States, Europe, and Japan. Patent applications can originate from any country.
- In 2005, the U.S. share of triadic patents was estimated at 37 percent, followed by the EU, 30 percent and Asia, 28 percent (see Figure 5). Asia's share of these important, economically valuable patents has been flat, unlike its rising share of U.S. patent applications. Four European countries (Finland, Switzerland, Germany, and Sweden) and Japan have a higher per capita and size-of-economy triadic patent family output than the United States.

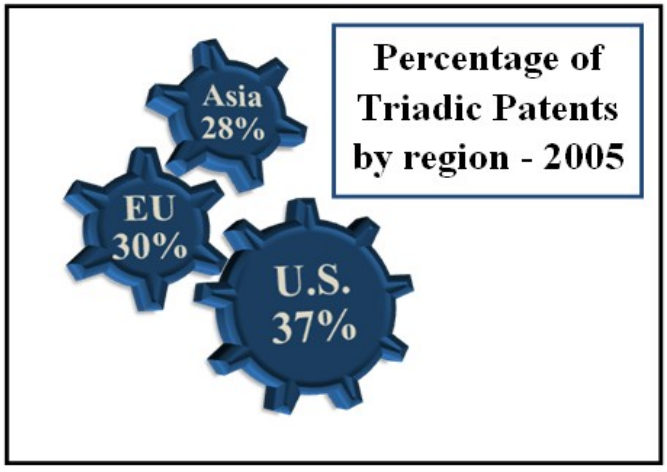

Figure 5: Percentage of Triadic Patents by Region, 2005 [12]

- U.S. inventors are the leading source of U.S. patents granted in two key technology areas: (1) information and communications technology (ICT) and (2) biotechnology. Asia is ranked second as a source of U.S. patent grants in ICT and third in biotechnology, and the EU is ranked third as a source in ICT and second in biotechnology" [12].

The National Science Board [12] provided the number of triadic patents ranked by the size of the economy (GDP) in 2003 for 30 countries. The top 13, in addition to the EU, are presented in Table 1. Note that some countries in the EU are listed separately to indicate their individual rank. Table 1 indicates the United States is not producing an amount of patents the size its economy dictates it should be producing. This is another indication that the U.S. leadership position in patents is being threatened.

Table 1: Triadic Patents by Size of Economy (GDP) for Inventors from Selected Regions/Countries/Economies, 2003 [12]

Region/Country/ Economy	**GDP – 2003**
Finland	5.04
Switzerland	5.43
Japan	5.02
Germany	4.51
Sweden	4.20
Israel	3.53
Netherlands	2.85
United States	2.28
EU	1.91
France	1.81
Denmark	1.60
United Kingdom	1.57
South Korea	1.09
Asia	1.08

Other Sources of Data

Other sources of data exist that confirm the findings of the National Science Board [12]. For example, the previously referenced World Intellectual Property Organization (WIPO) [13] has a 2008 report titled, "World Patent Report: A Statistical Review." This report is based on information supplied to WIPO by worldwide patent offices in annual surveys and data generated at WIPO during the Patent Cooperation Treaty application process.

Conclusion

The general trends reported here and described by the National Science Board [12] are indications that the United States is beginning to lose its global leadership in innovations and high-technology manufacturing.

- Increasing competition from the EU, Japan, and the emerging economies of China and India are threatening the U.S. leadership position in science and engineering.
- China has made remarkable progress; its world share of high-technology manufacturing has more than quadrupled during the past decade.
- U.S. trade balance moved to a deficit during the late 1990s because of faster growth of imports.
- Led by China, South Korea, and Taiwan, Asia is challenging the U.S. market position in science and technology industries and reducing the gap on technological innovation.
- China has rapidly risen to become a leading producer and exporter of high-technology manufacturing goods [12].

Using patents (more specifically triadic patent families) as a surrogate indicator of valued innovativeness, the United States is losing its lead in innovative ideas and products in the global market. Some of the patent-related indicators are:

- Asia has more than doubled its share in 2005 of U.S. patent applications, led by growth from Japan, South Korea, and Taiwan.
- U.S. patent applications from China and India are increasing.
- Four European countries (Finland, Switzerland, Germany, and Sweden) and Japan have a higher per capita and size-of-economy triadic patent family output than the United States [12].

Strategies to combat these trends are explored in a second paper presented at this conference by the authors of this paper [14]. It explores creativity and innovation as essential characteristics of engineers and scientists. It also investigates approaches to instill these characteristics in college and university students. Finally, it addresses the shortage of science and engineering graduates [14].

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