

ASPEN PUBLISHERS

JANUARY 2008

DEVOTED TO  
LEADERS IN THE  
INTELLECTUAL  
PROPERTY AND  
ENTERTAINMENT  
COMMUNITY

VOLUME 28 NUMBER 1

# *Licensing*

*Edited by the Law Firm of Grimes & Battersby*



# University Licensing

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## Foreign Inventors: Advancing Technology in the United States

Technological improvements are, for the most part, driven by the rate of invention, which has increased appreciably in recent years as measured by the rapidly growing number of patents awarded to universities and industries in the United States. [Hall, B.H., "Exploring the Patent Explosion," Working Paper Series, Number 10605, NBER (2004); Kortrum, S., "Research, Patenting and Technological Change," *Econometrica* 65:1389–1419 (1997).] The ability to patent university inventions was significantly enhanced by the passage of the Bayh-Dole Act of 1980, which allowed US universities to commercialize government funded research, which in turn has resulted in increased collaborations between academia and industry. Research is now frequently subcontracted by industries to universities, wherein a share of the royalties often are returned to the institutions, thereby permitting further research. Despite arguments that patenting increases costs, the benefit to the public of such advances cannot be disputed. Further, the industries often license or purchase the intellectual property rights from the university to any discovery resulting from the sponsored research, creating a win-win situation all the way around. Yet, until recently, few studies have analyzed the role of internationally-born immigrant graduate students, researchers or professors

in this innovation process at US universities or in the US patent process in general.

However, recent studies have shown that, in fact, foreign students, skilled immigrants and those with doctorates in science or engineering play a significant role in innovation in the United States, although many variables must be considered. [Wadhwa *et al.*, "'Brain-Drain' of Skilled U.S. Immigrant Entrepreneurs to Home Country Intellectual Property, the Immigration Backlog, and a Reverse Brain-Drain: America's New Immigrant Entrepreneurs," Part III of a Kauffman Foundation Study (August 22, 2007); available online at [www.kauffman.org](http://www.kauffman.org) and [papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1008366](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1008366); and Master of Engineering Management Program, of the Pratt School of Engineering at Duke University, and School of Information, U. C. Berkeley, "America's New Immigrant Entrepreneurs (January 4, 2007); available online at [www.dukenews.duke.edu/2007/01/engineerstudy.html](http://www.dukenews.duke.edu/2007/01/engineerstudy.html).] Of course, graduate students major in many programs at universities, not just science and engineering. Moreover, there are few identifiable factors that distinguish domestic from international inventors, so the information is difficult to differentiate and quantify. The domestic proportion of the graduate students at US universities has remained relatively constant at 65 percent over the years, but far fewer domestic students actually graduate (only 45 percent of the domestic students graduated during the 1990s). Thus, there

appears to have been a significant attrition of the US-born students prior to completing their graduate educations. Unlike the international students, the domestic graduate students often leave science for other fields, such as law or management, which may not be as attractive a career path in the US to foreign-born students. Nevertheless, larger enrollments of international graduate students in proportion to total numbers of US graduate students, appears to have recently resulted in a significant increase in patents awarded to universities and industries in the United States.

US Census data indicates that only 9 percent of US-born graduates work in the scientific fields, whereas 17 percent of foreign-born graduates remaining in the United States continue to work in science, with a significant percentage of those graduates focusing on chemistry. Relatively open access to international students has permitted US universities to draw the brightest graduate students in science and engineering from all over the world.

To examine this trend, the Duke researchers [*Id.*] developed a study to determine the impact of outsourcing and immigrant contributions to US competitiveness. But before beginning their analysis, the study group first had to establish research parameters. The target of the Duke study was not limited to universities, but rather attempted to document economic and intellectual contributions of immigrant technologists and engineers at the national level, but the results are readily extrapolated to the university community. The study considered a large sample of all US engineering and technical companies founded in the United States within the past 10 years (1995–2005) to determine whether a key founder of the

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company was a US immigrant. To evaluate intellectual property contributions, the Duke investigators considered the World Intellectual Property Organization (WIPO) Patent Cooperation Treaty (PCT) database for international patent applications filed in the United States. While the citizenship of each inventor must be recorded in a US patent application, apparently this parameter cannot be readily searched, so the Duke investigators turned to the PCT filings for determining intellectual property contributions. WIPO PCT applications represent a subset of patent applications filed with the US Patent and Trademark Office, but were considered likely to have a high global utility and contribute to US competitiveness.

First the researchers had to establish their definition of who would be counted as an “immigrant” in the United States for the purposes of the study. To put this into perspective, according to the 2000 US Census from 1990 to 2000, 12.5 million foreign-born citizens were granted US citizenship. According to the Kauffman Foundation report, more than one million skilled immigrant workers—including Indian and Chinese scientists and engineers—and their families are competing for 120,000 permanent US resident visas each year, fueling a “reverse brain-drain” with skilled workers returning to their home countries. March 2003 US Census data showed that 11.7 percent of the US population was foreign-born. [Larsen, L., “The Foreign-Born Population in the United States, 2003. P 20-551 (August 2004); See [www.census.gov/prod/2004pubs/p20-551.pdf](http://www.census.gov/prod/2004pubs/p20-551.pdf).] Immigrants from Latin America made up the largest portion of this group (53.3 percent), followed by Asia (25.0 percent) and Europe (13.7 percent).

While naturalized citizens were included within the “key founder” data, US naturalized citizens who filed a PCT application after becoming a citizen were not counted in the Duke study. As a result, the findings represent a very conservative estimate of the contributions of immigrants to the patent database. In addition, for statistical purposes, the Duke study limited the PCT database to only those patent applications that were filed through the US PCT Receiving Office between 1998 and 2006, although records were available since 1978. To create the statistical sample, records were extracted for published patents that named at least one applicant, who was not a US citizen, and who was also identified as residing within the United States at the time the application was filed. The number of US residents who filed PCT patent applications through the US Receiving Office that were published by WIPO during that nine-year period numbered approximately 340,000 PCT applications. The Duke team utilized the Neopatents’ proprietary Spore® Search software package to query the WIPO database.

According to the Duke study, 25.3 percent of engineering or technology-based companies that were started in the United States between 1995 and 2005 had at least one key founder who was an immigrant to the United States. Moreover, almost 80 percent of the immigrant-founded companies in the United States represented just two fields of industry: (1) semiconductor/computer/communications software and innovation, and (2) manufacturing-related services. Immigrants were discovered less often founding start-up companies in the defense/aerospace and environmental industries. Significantly,

for the identified companies, their founders tended to be highly educated in science, technology, math and engineering-related disciplines, with 96 percent holding bachelor’s degrees and 75 percent holding Masters or PhD degrees. [Compare these findings to the reported, total number of employment-based principals in the employment-based categories and their family members waiting for legal permanent residence in the United States in 2006 was estimated at 1,055,084. Additionally, there were an estimated 126,421 residents abroad also waiting for employment-based US legal permanent residence, adding up to a worldwide total of 1,181,505 in 2006.] In 2006 alone, these companies employed 450,000 workers and generated \$52 billion in revenue within the United States.

The Duke study reported that although Chinese (Mainland and Taiwan) and Indian immigrants comprise only about one percent of the total US population, immigrants from India founded more engineering and technology companies in the United States (26 percent) in the past decade than were started by immigrants in the total combination of the next four groups (from the United Kingdom, China, Taiwan, and Japan). While the distribution of these companies is uneven across the United States, states in which there were reported to be an above-average rate of immigrant-founded companies included: California (39 percent), New Jersey (38 percent), Georgia (30 percent), and Massachusetts (29 percent). States having a lower than average number of immigrant-founded companies included: Washington (11 percent), Ohio (14 percent), North Carolina (14 percent), and Texas (18 percent). Chinese-borne entrepreneurs were heavily concentrated in California (49 percent of

Mainland Chinese and 81 percent of Taiwanese companies located there); whereas Indian entrepreneurs have sizable concentrations in California and New Jersey (47 percent of all immigrant-founded startups), and the British comprise a presence in California and Georgia. Hispanics constitute the dominant group in Florida, where immigrants from Cuba, Columbia, Brazil, Venezuela, and Guatemala founded 35 percent of the immigrant-founded companies. At 17 percent, Israelis constitute the largest founding group in Massachusetts.

Based on the WIPO databases, foreign nationals residing in the United States, who were not naturalized citizens were named as inventors or co-inventors in ¼ of the PCT patent applications filed in the United States in 2006, tripling the numbers recorded in 1998 (an estimated 7.3 percent). Foreign nationals contributed to more than half of the international patents filed by a number of large, multi-national companies, including Qualcomm (72 percent), Merck & Co. (65 percent), General Electric (64 percent), Siemens (63 percent), and Cisco (60 percent). An astounding 41 percent of the patents filed by the US

government named one or more foreign nationals as inventors or co-inventors.

Consequently, it is evident that immigrant scholars, whether trained within the United States or abroad, including those with PhDs in science and/or engineering, have had a positive impact on the total number of filed patent applications, as well as the number of patents awarded to universities, industries and other enterprises. This finding underscores the contributions made by skilled immigrants to innovation at all levels of the US economy, as well as to the creation of new businesses and protected intellectual property in the United States—and it demonstrates that their contributions have increased over the past decade. Conservative estimates suggest that a 10 percent increase in the number of foreign graduate students would raise patent applications by 4.7 percent, raise university patent grants by 5.3 percent, and raise non-university patent grants by 6.7 percent. Following the 9/11 incidents, there were strong anti-immigrant sentiments in the United States, and certain US legislators advocated placing bans on open immigration into this country. But those

nationalistic restrictions have not only proven to be unnecessary, but to the contrary, increases in skilled immigration have had a positive, impact on patenting in the United States. As a result, reductions in the number of visas granted to foreign graduate students could significantly reduce US innovative activity.

The impact of these recent findings may be best summed up by Duke's Provost, Peter Lange, who has said that: "These findings are important, highlighting the invaluable contribution of foreign nationals to our country's technological and economic vitality. We know from our own experience here that students from China, India, and other nations can play an outstanding role in advancing knowledge and creating new jobs, especially in cutting-edge fields." Thus, it would appear that scholastically talented immigrants provide a previously unrecognized resource to US universities, and to the advancement of science and technology for the nation as a whole.

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