Proprietary Rights, Innovation, and Entrepreneurship: Evidence from Invalidated Gene Patents

Proposal for NBER Innovation Policy Grant

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Entrepreneurial firms play an important role in the development and commercialization of life science-related products (Chatterji 2009; Gans and Stern 2003; Lowe and Ziedonis 2006). Although survey evidence suggests that patent protection is particularly important for entrepreneurial firms in the life sciences (e.g., Graham et al. 2009), others suggest that a proliferation of intellectual property (IP) rights to genetic compounds could stifle incentives to innovate in the sector (Heller and Eisenberg 1998; Williams 2013).

This paper investigates the role of patents in entrepreneurial and innovative activities by exploiting an unexpected shift in the patentability of genetic compounds. On June 13, 2013, the U.S. Supreme Court rendered verdict in Association of Molecular Pathology v. Myriad Genetics (hereafter the "Myriad case"). As part of the decision, the Court unexpectedly declared that isolated genes are parts of nature and are therefore ineligible for patent protection. According to the American Medical Association, the ruling invalidated proprietary rights to over 6,000 isolated genes in humans alone, and thousands more in other organisms. From a research design perspective, the Supreme Court's ruling in the Myriad case is particularly useful. In addition to its unanticipated nature, the verdict withdrew patent rights to one type of genetic compound (isolated DNA) while preserving rights to another compound type (complementary DNA, or "cDNA"). This aspect of the case allows me to employ a difference-in-difference methodology. The treatment group comprises patents that claim isolated genes alone. The control group of patents claim both isolated genes and cDNAs.

In line with the theoretical predictions in the market for technology literature, I anticipate that the withdrawal of patent rights to isolated genes will reduce the technology licensing activities between startups and established firms. This prediction primarily hinges upon the notion of "paradox of disclosure": although the extent of profits earned from selling the idea is correlated with the degree to which the idea is disclosed, the idea is difficult to sell after the disclosure (Arrow 1962). Thus, to assure safeguarding ideas from expropriation, a strong IP rights regime should be in place. Removing such protection from genes, therefore, could make it more risky for startups to disclose their gene-related ideas to established firms to license their technologies. On the other side, without sufficient information on the idea, it would be difficult for established firms to evaluate the technologies that startups offer. The result may be a decline in the functionality of market for ideas which would deprive both startups from having access to the specialized complementary assets that large firms own and large firms from outsourcing innovation to startups with high research incentives.

Moreover, losing patent rights over genes can make it potentially more difficult for startups in persuading funding sources, specifically VCs, to invest in their firms. In their survey of high-tech companies, Graham et al. (2009) find a strong correlation between owning patents and receiving VC funding. They report that 73 percent of VCs consider patents as an important factor in their decision to fund biotechnology startups. Similarly, Farre-Mensta et al. (2017) report that a successful first-action from

patent examiners increases the likelihood of receiving VC funding (by ~53 percent) and speeds the fundraising activities of new patent owners.

Finally, I expect the withdrawal of patents to increase disclosure costs and contracting frictions, boosting the competition between startups and incumbent firms. Drawing on the findings of Galasso and Schankerman (2015), I also expect losing gene patents to reduce the level of innovation in the small firms substantially more than that in the large firms. After losing their patents, startups should be at higher risk of dissolution or an early acquisition. Overall, I predict a boost in acquisition activities and startup dissolutions in the biopharmaceutical industry following the removal of patent protection, a phenomenon that could lead to increased consolidation in the organization of R&D.

To examine these predictions and following Jensen and Murray's (2005) methodology, I compiled a dataset of the entire set of patented genetic sequences (~45,000 patents containing ~7 million sequences) and used the NCBI's BLAST service to identify the associated genes. Then, I conducted a text analysis to identify the patents that merely claimed isolated human genes (treatment group) and those that also claimed the cDNA (control group). Using a difference-in-difference methodology, my strategy is to estimate the impact of losing patent rights on "Novel Diagnostic Tests", "Number of Partnership Deals", "Acquisitions", "Startup Valuation", and "Startup Survival".

This study aims to contribute to the scholarship on IP rights, innovation, and entrepreneurship. It has been acknowledged by the Kauffman Foundation for Entrepreneurship, as a recipient of the 2018 Kauffman Dissertation Fellowship, and the Strategy Research Foundation, as a winner of the 2016 dissertation grant.

If awarded, I will use the NBER grant for cleaning, refining, and purchasing complementary data, research assistance for data matching and similar tasks, and travel for presenting the study (the proposal is accepted for presentation at the Strategic Management Society 2018 in Paris). Thank you for considering my application.

References:

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In The rate and direction of inventive activity: Economic and social factors (pp. 609-626). ***Princeton University Press.***

Chatterji, A. (2009). Spawned with a silver spoon? Entrepreneurial performance and innovation in the medical device industry**.** ***Strategic Management Journal***, 30(2), 185-206.

Farre-Mensa, J., Hegde, D., & Ljungqvist, A. (2017). What is a Patent Worth? Evidence from the US Patent "Lottery" (No. w23268). ***National Bureau of Economic Research***.

Galasso, A., & Schankerman, M. A. (2015). Patents Rights and Innovation by Small and Large Firms. ***(working paper)***

Gans, J. S., & Stern, S. (2003). The product market and the market for "ideas": commercialization strategies for technology entrepreneurs. ***Research Policy***, 32(2), 333-350.

Graham, S. J., Merges, R. P., Samuelson, P., & Sichelman, T. (2009). High technology entrepreneurs and the patent system: Results of the 2008 Berkeley patent survey. ***Berkeley Technology Law Journal***, 1255-1327.

Heller, M. A., & Eisenberg, R. S. (1998). Can patents deter innovation? The anticommons in biomedical research. ***Science***, 280(5364), 698-701.

Jensen, K., & Murray, F. (2005). Intellectual property landscape of the human genome. ***Science***, 310(5746), 239-240.

Lowe, R. A., & Ziedonis, A. A. (2006). Overoptimism and the performance of entrepreneurial firms. ***Management Science***, 52(2), 173-186.

Williams, H. L. (2013). Intellectual property rights and innovation: Evidence from the human genome. ***Journal of Political Economy***, 121(1), 1-27.