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Williams, H. 2013. "Intellectual Property Rights and Innovation: Evidence from the Human Genome." *Journal of Political Economy* 121 (1): 1–27.

Comment Matthew Mitchell

In their very interesting chapter, Cockburn, Henderson, and Stern make the case that artificial intelligence (AI) might serve as a general purpose technology in the production of innovations. My discussion centers on what this might mean for policy, and especially policies surrounding intellectual property (IP) protection. In particular, AI is likely to bring up new questions that are familiar from old IP debates about the balance between rewarding innovation and fears that this protection might in turn deter future innovation.

Is AI a Technology for Innovation or Imitation?

It is not obvious whether AI is a general purpose technology for innovation or a very efficient method of imitation. The answer has direct relevance for policy. A technology that made *innovation* cheaper would often (but not always) imply less need for strong IP protection, since the balance would swing toward limiting monopoly power and away from compensating innovation costs. To the extent that a technology reduces cost of *imitation*, however, it typically necessitates greater protection.

New technology is often useful for both innovation and imitation. For instance technologies like plastic molds, which can offer the possibility of new designs and therefore foster innovation, also lead to greater possibilities for reverse engineering. Machine learning is, in a sense, a sophisticated sort of mimicking; it sees what "works" (by some criterion) and finds ways to exploit that relationship. Therefore it seems that AI might be a general purpose technology for either innovation or imitation.

Consider a news aggregator. Many of these aggregators work because of some form of machine learning; they match the user to news stories that are predicted to be of interest. This is clearly a service that generates value, and would not exist in anything like its realized form in the absence of the underlying AI technology. But some news sites have argued that this constitutes infringement of their copyright. Semantically there is a question: Is the aggregator technology an innovation or is it imitation?

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Of course the answer is that it is both. It is much like the case of sequential innovations, where a later innovation builds on the earlier one, and at the same time uses and improves upon the prior. In those cases, to decide if the new innovation is a sufficient breakthrough on the old, words like "nonobvious" are employed in patent law. It is not completely clear how such words would apply to innovations that are made by machines; nonobviousness is designed in terms of a "person having ordinary skill in the art" and therefore is fundamentally about the human brain. How we will answer semantic questions like "what is obvious?" in a world where innovations are generated by machines will be central, and difficult, if we are to balance IP rewards and costs.

Situations like that of news aggregators have largely been managed, in practice, by the internet version of contracts. A news source can make its articles visible or invisible to the aggregator by blocking the content through a robots.txt file. That leaves only a competition concern: if news aggregators are few, they may still have monopoly power over creators of underlying content, making it difficult to solve problems simply by allowing content providers to opt out. The aggregator might control so much consumer attention that a news source cannot be viable without it.

Hammers That Make Nails

The aggregator example brings up the question of what policies might foster competition in a world where innovations are made using AI. Cockburn, Henderson, and Stern highlight the importance of data sharing and availability as an essential input in a world where the data itself is an input into the production of innovation by AI. This is clearly of critical importance. One issue that complicates policy is that the innovations may not only be produced *from* data, but also *generate* new data. Google's search engine generated data from users because it was a superior engine in the first place, but this can undoubtedly cement Google's market position. In a sense, asking the right questions or solving the right problems initially can generate users and data that lead to more innovations in the future. It is like a hammer that both needs nails to be productive, and also produces nails; being the first user of the hammer magnifies the advantage by creating more of the complementary input.

Here the economics literature on IP highlights two effects to balance: giving property rights to data (and not forcing the nails to be shared) is an encouragement to using the hammer in the first place (since it increases the value of the nails it produces) but also can make the hammer-nail technology less efficient for other firms (since they have less access to nails as an input). Striking the right balance on property rights for data strikes at the heart of the classic debate on how much competition is good for innovation.

Competition, Innovation, and Privacy

Whinston (2012) summarizes the classic forces of competition before and after innovation: Arrow (1962) suggests that ex ante competition is good for innovation, whereas Schumpeter (1942) argues that ex post competition is bad for innovation. Because today's innovations tend to lead to future innovations, for instance, through the data they generate if AI were involved, there is unfortunately no clear distinction between ex ante and ex post to serve as a rule. In the case of data, there is another force: privacy. It may be distasteful to enforce a data-sharing standard that would lead to multiple firms having the inputs necessary to attack the same problem. Goldfarb and Tucker (2012) point out that this means that privacy policy is connected to innovation policy more generally. Restrictions on data ownership will mean restrictions on a vital input into the innovation production process when innovations are produced with AI.

Since privacy concerns will likely mean less competition for innovation technologies built on AI, policymakers will have to be vigilant about insufficient competition. Since concern about insufficient competition harming innovation is largely about a lack of ex ante competition, the most important areas will be innovations in the early stage, relatively uncluttered areas of the technology space. Tailoring innovation policy in a new world of AI-generated innovations will require taking care to heed the general lessons of balancing benefits and costs of market power, while at the same time taking seriously the important new issues that are specific to the AI context. Cockburn, Henderson, and Stern's work helps us to better understand that context.

References

Arrow, K. 1962. "Economic Welfare and the Allocation of Resources to Invention." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, edited by Universities-National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Councils, 467–92. Princeton, NJ: Princeton University Press.

Goldfarb, Avi, and Catherine Tucker. 2012. "Privacy and Innovation." In *Innovation Policy and the Economy*, vol. 12, edited by Josh Lerner and Scott Stern, 65–89. Chicago: University of Chicago Press.

Schumpeter, Joseph. 1942. *Capitalism, Socialism and Democracy*. New York: Harper & Brothers.

Whinston, Michael D. 2012. "Comment on 'Competition and Innovation: Did Arrow Hit the Bull's Eye?'" In *The Rate and Direction of Inventive Activity Revisited*, edited by Josh Lerner and Scott Stern, 404–10. Chicago: University of Chicago Press.