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My research agenda focuses on investigating the causes and consequences of technological change in health care markets. The broad goal of this agenda is to shed light on the economics of innovation in a context – health care – that has important consequences for human health and welfare, and which is critical from a fiscal policy perspective. In this statement I describe my two main lines of research: investigating the impact of patent policy on technological change in health care markets, and investigating the consequences of technological change in health care markets.

My research agenda has been generously supported by an Alfred P. Sloan Research Fellowship (2015-2017), a Kauffman Junior Faculty Fellowship in Entrepreneurship (2014-2016), a National Institutes of Health U01 grant (“Empirical studies of the development and diffusion of medical technologies,” 2013-2018), and a National Science Foundation CAREER grant (“Empirical studies of innovation in health care markets,” 2012-2017).

I. Investigating the impact of patent policy on technological change in health care markets

I.A. How does patent policy affect the rate and direction of innovation?

Academics and policymakers have long recognized that competitive markets may under-incentivize innovation. This concern has motivated the design of public policies such as the patent system, which aims to increase research investments into new technologies by allowing inventors to capture a higher share of the social returns to their research investments. A well-developed theoretical literature has analyzed optimal patent policy, with a focus on the trade-off between providing incentives for the development of new technologies and the deadweight loss from higher prices during the life of the patent. While such theoretical models – and, importantly, public policies – typically assume that stronger (e.g. longer or broader) patents will induce additional research investments, there is remarkably little empirical evidence on how patents affect research investments in practice.

This question has been difficult to tackle empirically for two reasons. First, measuring research investments is challenging. Economists have long used patent data itself as a measure of research investments. However, because patent laws change the incentives to file for patents on existing research, patent data are not well suited to investigating how patent laws affect “real” research investments. Second, finding variation in patent protection is difficult. On paper, the patent system is uniform, providing a 20-year term for all inventions. While some cross-country variation in patent laws has existed historically, because innovations are developed for a global market, country-specific patent law changes may capture a relatively small source of variation in global incentives.

The first part of my research agenda attempts to overcome both of these challenges in order to develop empirical estimates of the key parameters needed to inform optimal patent policy. By combining detailed new measures of research investments in health care markets with novel sources of variation in the effective patent terms provided to otherwise similar inventions, my work aims to construct frameworks within which we can infer the volume, type, and value of “missing” research investments that would have occurred under counterfactual patent policies.

Emblematic of this line of work is a joint paper with Eric Budish (Chicago Booth) and Benjamin Roin (MIT Sloan), “Do firms underinvest in long-term research? Evidence from cancer clinical trials” (forthcoming, American Economic Review). We investigate a novel source of variation in effective patent terms based on the following idea: by requiring shorter (post-patent filing) clinical trials, drugs treating late-stage diseases can be brought to market comparatively quickly – thus receiving longer effective patent terms – relative to drugs treating early-stage diseases. Using newly collected data, we document several sources of evidence that together are consistent with private research investments being distorted away from long-term projects such as drugs to prevent or treat early-stage cancers. A back-of-the-envelope calculation suggests that this distortion has quantitatively important implications for the survival outcomes of US cancer patients. This paper was awarded the 2013 Kauffman Foundation/iHEA Award for Health Care Entrepreneurship and Innovation Research for the “best original research paper on health care entrepreneurship.”
While that paper documents evidence that private research investments are distorted away from long-term projects, it is not clear that patents per se are the mechanism: specifically, we are unable to rule out excess impatience of private firms (relative to the social planner) as an alternative mechanism for our measured distortion. To more directly investigate how patents impact research investments, Budish, Roin, and I are pursuing a second joint paper, “Missing markets for innovation: Evidence from new uses of old drugs” (in preparation). Pharmaceuticals are approved to treat a specific disease (say, diabetes), but in many cases evidence accumulates that any given drug can also effectively treat other diseases (say, cancer). However, once the original patent expires, discoveries of new uses of that drug receive little or no effective patent protection: because pharmaceutical firms lack a technology for monitoring the diseases for which physicians prescribe drugs, there is no way for the potential developer of a new use of an old drug to charge a price above marginal cost once generic entry has occurred. We use a simple theoretical model to formalize this distortion and analyze potential policy and market design responses, and our empirical results provide evidence that research investments into new uses of old drugs strongly respond to this variation in effective patent protection.

I.B. How do intellectual property rights affect follow-on innovation?

The papers above all empirically test a classic question in the economics of innovation: does stronger patent protection induce additional research investments? That prediction emerges unambiguously from a class of theoretical models that treat innovations as isolated discoveries. However, in practice innovation is often “cumulative,” in the sense that any given discovery is also an input into later follow-on discoveries. In such cases, optimal patent policy will depend in part on how patents on existing technologies affect follow-on innovation. A well-developed literature has documented theoretically ambiguous predictions on how patents affect follow-on innovation, but there is little available empirical evidence.

In “Intellectual property rights and innovation: Evidence from the human genome” (2013, Journal of Political Economy), I use newly collected data to document evidence that a non-patent form of data exclusivity on sequenced human genes reduced subsequent scientific research and product development on those genes by approximately 30 percent. My estimates were cited in several briefs submitted to the recent AMP v. Myriad case, in which the US Supreme Court ruled that human genes should not be patentable because gene patents would “inhibit future innovation.” However, survey evidence suggests that unlike the non-patent form of data exclusivity that I studied in this paper, patents on human genes may not discourage follow-on innovation, largely because patents (unlike data exclusivity) generally preserve open access to materials for academic scientists at the exploratory research stage.

In joint work with Bhaven Sampat (Columbia School of Public Health), “How do patents affect follow-on innovation? Evidence from the human genome” (in draft form), we investigate how patents impact follow-on innovation in order to speak directly to patent policy and to this US Supreme Court case. Specifically, we use newly collected data and two novel quasi-experimental approaches to investigate how gene patents affect follow-on innovation. First, we compare genes claimed in accepted and rejected patent applications. Second, we construct a new instrumental variable for which patent applications are granted patents, based on the “leniency” of the (conditionally randomly assigned) patent examiner. Both approaches suggest gene patents have not reduced follow-on innovation; we can reject declines in follow-on innovation on the order of my earlier estimates. Taken together, the evidence from these two papers suggests that the traditional patent trade-off (ex ante incentives versus deadweight loss) may be sufficient to analyze optimal patent policy design, but that non-patent policies governing access to materials – such as data exclusivity – may have important effects on follow-on innovation.

As a side note, I expect this examiner “leniency” variation to prove useful for investigating the impacts of patents in many other contexts.

II. Investigating the consequences of technological change in health care markets

The second part of my research agenda aims to more directly investigate the implications of technological change in health care markets. Because technological change is viewed as a key driver of health care cost growth, policy efforts to control health care costs are often aimed at limiting the use of medical technologies. For example, many
have interpreted the large observed within-US geographic variation in Medicare spending as evidence that as much as 20-30 percent of Medicare spending (an amount on the order of several percentage points of GDP) could be eliminated with no adverse health effects.

In joint work with Amy Finkelstein (MIT) and Matthew Gentzkow (Chicago Booth), “Sources of geographic variation in health care: Evidence from patient migration” (revise-and-resubmit, Quarterly Journal of Economics), we exploit the migration of Medicare patients across geographic markets to decompose the relative importance of demand (patients) and supply (provider) factors in explaining geographic variation in Medicare spending. Our baseline estimates suggest that 40-50 percent of geographic variation in Medicare spending is attributable to patient demand, with the remainder due to place-specific factors such as doctors and hospitals.

While these results are not sufficient to draw strong conclusions about efficiency, the fact that both patient demand and supply-side factors appear to account for substantial shares of the geographic variation in Medicare spending suggests a large potential scope for policy interventions targeting either patients or health care providers. In joint work with Liran Einav (Stanford) and Finkelstein, “Paying on the margin for medical care: Evidence from breast cancer treatments” (revise-and-resubmit, American Economic Journal: Economic Policy), we present a simple graphical framework to illustrate the potential welfare gains from one such policy: a “top-up” health insurance policy that allows patients to pay the incremental price for more expensive medical technologies. We illustrate this welfare analysis in the context of treatment choices among breast cancer patients.

Of course, in general the welfare impacts of such public policies that change patients’ or physicians’ incentives to use various medical technologies depend in part on the health benefits of those technologies. In joint work with Douglas Almond (Columbia), Joseph Doyle (MIT Sloan), and Amanda Kowalski (Yale), “Estimating marginal returns to medical care: Evidence from at-risk newborns” (2010, Quarterly Journal of Economics), we propose a new method for valuing the returns to medical spending based on discontinuities generated by diagnostic thresholds (in our case, the “very low birth weight” threshold for infants born near 1500 grams). Using a regression discontinuity approach, we estimate that medical care saves at-risk newborns at a cost well below most value-of-life estimates. This paper was awarded the 2011 Garfield Economic Impact Award for “outstanding research that illustrates how medical or health research impacts the economy.” In follow-up joint work with Alice Chen (USC) and Emily Oster (Brown), “Why is infant mortality higher in the US than in Europe?” (in draft form), we investigate the role of medical and non-medical factors in explaining the substantial – and poorly understood – infant mortality disadvantage of the US relative to peer countries.

Finally, in more preliminary joint work, Finkelstein, Gentzkow, and I are pursuing a second joint paper, “Geographic variation in health care production functions: Evidence from patient migration” (in preparation) in which we develop a new approach to estimating the value of health spending, again taking advantage of the migration of Medicare patients across geographic markets but here relating patient health outcomes (specifically, mortality) to various area-level variables that characterize the health care production functions of different geographic areas.