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Essays on Health Economics

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Abstract: This dissertation explores policy-relevant issues in the healthcare sector, from strategic pricing in the health insurance industry, to the role of licensing in pharmaceutical innovations, to cross-sectional variation in physician supply. The first chapter investigate whether the private firms that provide prescription drug insurance through Medicare Part D exploit consumer inertia when setting prices. The second chapter explores the role of increased downstream demand in facilitating inter-firm cooperation in the pharmaceutical industry, where licensing is a common form of collaboration between upstream innovators and downstream commercializers. The third chapter investigates the differential effects of medical schools on the supply of physician across regions.

Category: Technology & Innovation: Original Intellectual Property and Corporate Research & Development, Firm & Industry Dynamics, Health Economics

Keywords: Health Insurance Regulation, Pricing, Inertia, Innovation, Licensing

Executive Summary

Key Take-aways

This dissertation explores a number of policy-oriented issues in the healthcare sector. The second chapter (coauthored with Manuel Hermosilla) focuses on the pharmaceutical industry, where licensing is a common form of collaboration between upstream innovators and downstream commercializers, and investigates the role of increased downstream demand in facilitating inter-firm cooperation. We propose a simple model of licensing with heterogeneous match quality which predicts that positive demand shocks will increase the likelihood of licensing and improve match quality by reducing the relative importance of transaction costs. We then use the differential impacts of the introduction of Medicare Part D across drug categories targeting different ages of consumers as a source of variation in demand, and document empirical evidence consistent with the model.

The key results and take-aways are as follows.

- The number of licensing deals for drugs affected by positive demand shocks from the enactment of Medicare Part D increased by about 60% in the years that followed the program's enactment.
- The effect was short-lived (5 years) and can be traced back to as early as the couple years following the program's announcement.
- The derived elasticity of licensing-based cooperation with respect to market size is 0.71. Even attaching modest productivity gains to inter-firm cooperation, this estimate suggests that the intermediary role of market size could be a meaningful determinant of overall innovative productivity.
- A larger market size helps materialize another layer of productivity gains, by improving the quality of match between the characteristics of each developing technology and the capabilities contributed by the cooperating pharmaceutical commercializer.

We contribute to the analysis of the impacts of public policies on innovation. Existing research has identified various channels by which public policies could impact the rate and direction of innovation. Our results suggest that these dynamic impacts may not only operate through the rate of future R&D investment, but also through the extent to which inter-firm collaboration can exploit its potential returns.

Chapter 1

The first chapter explores strategic insurer pricing in response to consumer inertia. A growing literature has documented evidence that consumers in health insurance markets are inertial, or behave as though they face substantial switching costs in choosing a health insurance plan. I investigate whether the private firms that provide prescription drug insurance through Medicare Part D exploit this inertia when setting prices. I first document descriptive evidence consistent with insurers initially setting low prices in order to “invest” in future demand before later raising prices to “harvest” inertial consumers. I then apply a two-step estimation approach following Bajari, Benkard and Levin (2007) to explore the implications of these invest and harvest incentives for equilibrium pricing, finding that on net, demand inertia reduces equilibrium prices (i.e. the invest incentive dominates the harvest incentive). Finally, I evaluate welfare consequences of policies that could be used to constrain insurers' ability to conduct such “invest-then-harvest” pricing patterns. I find, for example, that a policy change to cap premium increases would improve consumer welfare by both lowering average premiums and smoothing prices over time.

Chapter 2

Technological innovation is regarded as a primary source of improvements to economic welfare and growth. This notion is particularly palpable in healthcare, where the availability of new treatments can be directly linked to higher longevity, better clinical outcomes, and overall health improvements (Murphy and Topel, 2003, 2006; Lichtenberg, 1996, 2010). Early insights (Schumpeter, 1942; Nordhaus, 1969) and subsequent research converge on the idea that firms' aspiration to rip the monetary rewards derived from commercialization constitutes a leading factor

propelling the innovation of new technologies. This suggests that larger market sizes exert a stronger pulling force, increasing R&D investment and consequently, enabling higher innovation rates.

The causal impact of market size on innovation has been widely studied, primarily by an empirical literature focusing on the identification of a key statistic: the elasticity of innovation to market size. Due to its data richness and paramount importance, the pharmaceutical industry has become a preferred arena for this type of research. Despite the fact that disparities in the assortment of empirical approaches and used metrics makes it hard to assess the consistency of the elasticity estimates in this literature (De Mouzon et al., 2015), the role of market size has been invariably constrained to the determination of R&D investment decisions, excluding the possibility that it could also operate by altering the rate at which inputs are converted into outputs.

We argue that market size may not only impact innovative outcomes through the determination of R&D investment decisions, but also through an intermediation effect: the facilitation of inter-firm cooperation oriented at the development and commercialization of developing new technologies. It has long been argued this type of cooperation can increase R&D productivity by pooling firms' complementary capabilities (e.g., Teece, 1986; Gans et al., 2002; Spulber, 2014) implying that, by fostering the exploitation of inter-firm complementarities, larger market sizes could be associated to an improved rate of conversion of inputs into outputs. That is, market size may not only exert pulling force on innovation, but also a catalyzing one. A direct corollary of this argument is that a larger market sizes could be associated to higher rates of innovative output (i.e., new technologies available to consumers) even if the amount of inputs (R&D investments) were to remain constant.

Productivity gains from inter-firm cooperation appear particularly relevant in the pharmaceutical industry, where clinical development requires the application of a wide range of skills and there are important returns to experience and diversification (Cockburn and Henderson, 2001; Dranove and Meltzer, 1994). Under the current industry configuration, highly specialized entrepreneurial

biotech firms focus on the early stages of the innovation process, translating novel scientific insights into embryonic technologies. These firms, however, typically lack a set of important capabilities needed to develop compounds through late stages (Powell and Brantley, 1992; Powell, 1996). By licensing their developing technologies, biotech firms are able to access these capabilities from experienced pharmaceutical commercializer partners, increasing the probability that a new treatment will become available to consumers (Danzon et al., 2005) and/or do so in a shorter time frame. This rationale is widely recognized and often made explicit when licensing agreements are announced.

Set in the context of the pharmaceutical industry, we uncover a causal impact of market size on the extent of inter-firm cooperation oriented at the innovation of new technologies. Our empirical strategy exploits the impacts of the 2003 passage of Medicare Part D (henceforth “Part D”) on the patterns of drug candidate licensing. This program constituted a significant expansion of prescription drug expenditure coverage for Medicare enrollees, increasing the expected US market size for treatments targeting conditions that are more prevalent among the enrolled population. Since Medicare primarily serves people 65 years and older, treatments for conditions with higher prevalence among elderly populations had a higher degree of exposure to the Part D shock. Following the approach of previous research, we use health insurance and drug expenditure data to produce a measure of shock exposure for each of the developing treatments in our sample. We then compare rates of licensing activity before and after the program's enactment, across treatments with varying degrees of exposure to the shock. Due to the international character of the drug candidate licensing market and the irrelevance of Medicare insurance outside the US, we introduce a third dimension of comparison: whether or not licensing agreements included the US among licensed territories.

Econometric results obtained with this triple-difference strategy suggest that the number of licensing deals encompassing treatments with higher exposure increased by about 60% in the years

that followed the program's enactment. The effect was short-lived (5 years) and can be traced back to as early as the couple years following the program's announcement. We use these results to derive what is for us a clean estimate of a novel statistic - the elasticity of licensing-based cooperation to market size - which results in value of 0.71. Even attaching modest productivity gains to inter-firm cooperation, this estimate suggests that the intermediary role of market size could be a meaningful determinant of overall innovative productivity.

The immediacy of the cooperation surge is an important component of the analysis: it implies that the effect unfolded over a period of time in which, due to the relatively long times required for the completion of each stage of the drug development process, the supply of developing treatments available for licensing was fixed. Blume-Kohout and Sood (2013) and Dranove et al. (2014) analyze the impact of Part D on R&D investment decisions, identifying a significant increase in new clinical trials for treatments with higher exposure to the shock - a robust pull effect. This effect, however, manifested itself with a lag: it was not present before 2006, and mostly noticeable after 2008, once the bulk of the Part D-fueled surge in cooperation had already taken place. Consequently, our results cannot be explained by an increased supply of developing compounds available for licensing and therefore point to an impact operating over the intensive margin - an increase in probability that each developing technology will be the subject of cooperation. Consistent with this finding, we present a simple theoretical framework which establishes the intermediary role of technology licensing holding constant the amount of inputs (R&D investment) used in the process.

We draw on the literature on Markets for Technology (MFT) to rationalize these results. A central message from this stream from research is that inter-firm cooperation may be hindered by the presence of important contracting frictions - broadly labeled as transaction costs - rooted on problems such as costly search and negotiation, asymmetric information and bargaining power, among others (Arora et al., 2001). The presence of transaction costs reduce the return to cooperation and can often times preclude it (Spulber, 2014; Agrawal et al., 2014). As shown by the model,

transaction costs imply the existence of a pool of developing technologies for which cooperation is not valuable enough. For these technologies, cooperation is precluded at the baseline market size level. A larger market size facilitates cooperation by reducing the importance of transaction costs relative to gains of cooperation. The model shows that, in absence of transaction costs, the identified Part D-fueled licensing surge could not be rationalized because all technologies would have been the subject of cooperation regardless of market size. A direct corollary is that the identified elasticity of cooperation to market size is a function of both transaction costs and productivity gains derived from cooperation.

Our model and empirical results further suggest that a larger market size help to materialize a second layer of productivity gains. These are based on an improved matching between the characteristics of each developing technology and the capabilities contributed by the cooperating pharmaceutical commercializer. Drug candidates being developed at early stages (which in the model we refer to as “technological cores”) are developed into a set of different treatments (“sub-technologies”) fine-tuned versions of the compounds, optimized and tested in late stage clinical trials for the treatment of specific conditions. First-best matching would pair each of these treatments with the commercializer who possesses the best capabilities to develop each of them. But since the treatments associated to a compound's may span diverse therapeutical areas, first-best matching may require different complementary capabilities, and thus a different cooperating commercializer for each of them. This unbundling of treatments into individual cooperation agreements, however, would require incurring additional transaction costs. In analogous fashion to the mechanics underlying the main effect, a larger market size may reduce the relative importance of these additional transaction costs, prompting the unbundling of treatments into individual licensing agreements. Our empirical results show that, following the program's passage, treatments licensed for territories including the US and targeting a population with greater participation of

Medicare enrollees were significantly more likely to be packaged into narrower scope (often single-indication) licensing deals than their non-Medicare-oriented counterparts.

Gains derived from cooperative development and commercialization are not restricted to higher productivity in the technical sense used here. The literature on MFT (Arora et al., 2001) and its precursors (e.g. Teece, 1986) make this point emphatically: cooperation gains can also be derived from the avoidance of duplicative investment in co-specialized assets (Teece, 1986) or the preservation of downstream market power (Gans et al., 2002). Both of these types of gains are likely to be relevant in the pharmaceutical industry, as prescription drug markets tend to be concentrated within each therapeutic area (Malerba and Orsenigo, 2002) and costly co-specialized assets (manufacturing facilities, branded reputation, specialized sales-forces) are required for commercialization (Levine, 2009). Our analysis of section 2.7, however, suggests that these types of cooperation gains were unlikely to have prompted the surge in cooperation following Part D's enactment.

Our study offers three main contributions. First, it adds to the literature studying the functioning of Markets for Technology (MFT) by shedding some light on the role of downstream demand. A second contribution is made to the literatures of endogenous growth and directed technical change, which view the pace of innovation as a function of expected market profits. Our results show that the formation of alliances can mediate the relationship between R&D investments fueled by the expectations of higher returns and their outcomes in terms of growth and technical change. Finally, we contribute to the analysis of the impacts of public policies on innovation. Existing research has identified various channels by which public policies could impact the rate and direction of innovation. Our results suggest that these dynamic impacts may not only operate through the rate of future R&D investment, but also through the extent to which inter-firm collaboration can exploit its potential returns.

Chapter 3

Using US county-level data on physician stock from the Area Resource File, the third chapter is devoted to uncovering and understanding the differential effects of medical schools on the supply of physician across regions. I use a difference-in-difference framework to compare changes in physician supply in areas closer to new medical school entries with regions further away. I find that a new medical school increased the physician supply by one to three times the county average level in the county where the medical school was located, relative to other counties. The broader regional effect was smaller but still substantial - a new medical school increased physician supply by one fourth to two thirds of the sample average in counties within 50 miles, relative to counties farther away. When tracking the effect over time, I find that a new medical school had the same impact in the year of entry and in the following 20 years, which indicates that most of the impacts could be attributed to the immediate responses. I find no effect on the physician supply in most of the pre-entry years, which supports the identifying assumption that locations of new medical schools were not correlated with other underlying determinants of physician supply.

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