Title:

**Software-Driven Innovation and Medical Technology**

Abstract:

There is a longstanding debate about whether technological innovation enables the rise of new entrants, or reinforces incumbent advantages. The ongoing digital transformation of medicine represents a unique opportunity to revisit this debate in the context of health care, an industry that now represents nearly 18% of the U.S. economy. In 2016, over 700 medical devices containing software were cleared for marketing by the FDA, almost double the number approved a decade earlier. What types of firms are most likely to lead digital innovation in health care? And do traditional factors such as geographic specialization, experience, and firm revenues predict this type of innovation? We use unstructured text data on new medical devices, recovered through automated scraping, to study digital innovation in this industry. Using supervised document classification and other natural language processing tools, we analyze the content of over 33,000 devices over the years 2002-2016. We first document the growth of software and networking capabilities and find significant heterogeneities across medical specialty areas. We then use detailed firm data to understand the characteristics of the firms bringing digital technologies to market and find strong evidence for the importance of firm experience with software products. VC funding and location in a cluster are predictors of follow-on digital innovation, but not novel innovation, while public firms are more likely to engage in first-time product digitizations. We find several pieces of evidence that support within-firm positive spillovers from software inclusion in one product to another, consistent with a low marginal cost of doing so.

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