

Application for NBER Project on the Economics of Digitization Meeting

Contact information

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Course of Study

I am in my fifth year of the economics PhD program at the University of Virginia (UVa). I received an M.A. in economics in December of 2013, completed the requisite coursework for the PhD program in the spring of 2014, and my dissertation proposal was accepted in April of 2015. I expect to complete my dissertation by the spring of 2018. My advisors are Simon Anderson and Federico Ciliberto, though my work continues to benefit from numerous conversations with faculty members at UVa and elsewhere.

In my coursework my primary area of study was industrial organization (IO), and my secondary area of study was labor economics.

The two-course IO sequence consisted of a theoretical course with Simon Anderson, and an empirical course with Federico Ciliberto. The theoretical course spanned a wide variety of topics, with particular emphasis on logit demand, price discrimination, and the theory of two-sided markets. The empirical IO course again covered a wide variety of topics, with particular focus on BLP-style demand estimation, the modeling and estimation of entry games, and a broad overview of dynamic models.

My secondary focus on labor economics was chosen in large part to expose myself to and train myself in a wide variety of applied econometric approaches. UVa's first labor course, taught by Sarah Turner, emphasizes a number of reduced form empirical approaches, while the second course, taught by Steve Stern, is focused entirely on structural modeling approaches.

In addition to these primary areas of focus, I completed the public economics sequence and have completed or sat in on a number of econometrics courses. In particular, I sat in on a course on Big Data Econometrics taught by Denis Nekipelov in the spring of 2015.

While I have not taken a class specifically focused on computer programming I have been exposed to programming in a number of my courses, with particular attention placed on working in Stata and MATLAB. While enrolled at UVa I have also taught myself Python, MySQL, Git, and a variety of "Big Data" systems (e.g., Hadoop, Google BigQuery) outside of class. My research code is run primarily in Python, MySQL, and Google BigQuery.

Research Interests

I am interested in how technological advances are changing how firms compete and choose to innovate. In particular, much of my current research is focused on understanding how the increased digitization of consumer durables is changing the manner in which firms compete in those industries. As products become more software-dependent and internet-connected, firms will 1) be able to more easily update products without requiring consumers to replace their existing products, and 2) more easily engage in different or mixed forms of monetization.

This first change, the ability to update products past the point of sale, effectively changes the nature of competition in durable good industries – rather than competing primarily through prices and longer-term innovation, firms will be able to differentiate themselves through shorter-term updates. In a standard durable goods game, firms compete against other firms to make a sale, and against the consumer to convince the consumer to replace his or her existing product. Digitization has the potential to de-

emphasize this latter dimension of competition in favor of competing to *keep* consumers from looking for a replacement product. By providing incremental quality increases to a product, firms can keep the consumer from exploring replacements, and therefore from exploring the firm's competitors' offerings.

The second change due to digitization, the ability to engage in different or mixed forms of monetization, reflects the expansion of monetization strategies that were previously primarily seen in media markets. The inclusion of advanced software and ever-present internet connections in digitized goods lowers barriers to monetizing products through advertisements, micro-transactions (and therefore so-called freemium pricing models), subscriptions, or some combination of these. Again, this is a departure from the typical durable goods scenario. In many cases, consumers no longer pay once for a product and then use it until it is replaced. Instead, consumers may continuously pay for a product, either through the disutility of viewing ads or through continued payments via micro-transactions or subscriptions. (Note that while many expensive durable goods are often purchased through a payment plan, this differs from a subscription as a payment plan is finite, whereas a subscription will necessarily continue through the life of the product.)

In my dissertation, I study the smartphone application (app) industry. The app industry represents a limiting case of digitized durable goods – the products are fully digital. In order to understand how the the ability to provide downloadable product updates affects innovation rates, I construct and estimate a dynamic model of the supply and demand of apps, which accounts for the various forms of product monetization seen in app markets. My model captures the effect of updates on consumers' purchases and app-use decisions, which in turn allows me to capture the full effect of updates on developers' profits. I conduct a series of counterfactual analyses to understand how restricting app developers' ability to update their products affects the rate at which they innovate and update their apps. Future work will investigate how firms choose monetization strategies as well as how and why the adoption of monetization strategies differs across app markets. My results will be relevant to both the growing app industry, but also more generally as they will provide a context for studying how digitization will affect other durable good industries.

A significant part of my dissertation work is collecting data on app markets. I currently collect daily data on all apps in Apple's App Store. In addition, I continue to meet and speak with individual developers in order to collect additional data directly from them. I employ both supervised and unsupervised learning techniques to analyze and prepare my data in order to use it in my structural model of the industry.

In addition to my dissertation work, I am continuing work on two other projects. The first studies how platform rules can affect firms' strategic behavior. In particular, I am studying how Apple's policy of resetting apps' consumer review scores following a product update affects firms' decisions regarding how and when to update their products. The second is a theoretical investigation of how technological changes in online ad markets are affecting the behavior of online platforms that are financed through both subscriptions and advertisements, such as Hulu, Spotify, or YouTube.

Attending the graduate tutorial and meeting of the NBER project on the Economics of Digitization for the last two years has been very helpful for both my research and my development as an economist. I expect the same will be true for the 2017 meeting. I appreciate your consideration for this funding.