

# Application for NBER Project on the Economics of Digitization Meeting

## Contact information

Ben Leyden  
leyden@virginia.edu  
cell: (336) 908-1527  
office: (434) 924-7883

Monroe Hall, Rm. 132  
Department of Economics at UVa  
PO Box 400182  
Charlottesville, VA 22904-4182

## Course of Study

I am in the fourth 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 on April of 2015. I expect to complete my dissertation by the spring of 2017. 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

In broad terms, I am interested in how technological advances are changing how firms compete. 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 be able to more easily update products without requiring consumers to replace their existing products. This change in technology effectively opens a new dimension for competition – rather than competing in prices and longer-term innovation, firms will be able to differentiate themselves through shorter-term updates.

As an example, consider the electronic car manufacturer Tesla. In January 2015, Tesla released a downloadable update for their Model S P85D car, which decreased the time required to accelerate from 0 to 60 miles-per-hour by a tenth of a second, and in October 2015, Tesla released an additional update that made it possible for Tesla cars to, under certain circumstances, drive themselves. As other car manufacturers begin to integrate software in their products to the extent Tesla has it is easy to imagine firms competing with each other through updates such as these.

The extreme case of an industry with the ability to provide downloadable product updates is the smartphone application (app) industry, which I study in my dissertation. 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. My model captures the effect of updates on consumers' purchase and app-use decisions, which in turn allows me to capture the full effect of updates on developers' profits. I plan to 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. My results will be relevant to both the growing app industry, but also more generally as they will provide a context for thinking about and studying how digitization will affect other 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, and am in the process of developing systems to collect similar data for the Google Play 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 have begun work on two other projects. The first is a theoretical model of in-app purchases (IAPs), or within-app micro-transactions, which illustrate the conflicting incentives developer face when choosing how to price an app and IAPs. 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 last March was very helpful for both my research and my development as an economist. I expect the same will be true for the 2016 meeting. I appreciate your consideration for this funding.