

Application for NBER Digitization Tutorial, March 2016

Contact Information

Ankur Chavda

achavda@mit.edu

MIT Sloan School of Management

100 Main Street, E62-343

Cambridge, MA 02142

Course of Study

I am currently a third year in the Technological Innovation, Entrepreneurship and Strategic Management program at MIT Sloan. Although my program does not have majors or minors, students usually select economics or sociology as a core discipline; I am pursuing the economics track. I have taken the following courses in my first two years in the program prior to passing generals:

Subject Number	Subject Title	Instructor
14.121	Microeconomic Theory I	Townsend
14.122	Microeconomic Theory II	Ellison
15.342	Organizations and Environments	Kacperczyk
15.347	Designing Empirical Research in the Social Sciences	Silbey
ECON 2110	Econometrics I	Kasy / Chamberlain
14.123	Microeconomic Theory III	Yildiz
14.124	Microeconomic Theory IV	Holmstrom
ECON 2120	Introduction to Applied Econometrics	Chamberlain
15.357	Economics of Ideas, Innovation and Entrepreneurship	Stern/Azoulay
HBS 4561	Empirical Study of Innovation and Digitization	Greenstein/Lakhani
14.271	Industrial Organization I	Ellison
14.282	Organizational Economics	Whinston/Rantakari
14.385	Nonlinear Econometric Analysis	Chernozhukov/Newey
14.126	Game Theory	Manea
14.662	Labor Economics II	Autor / Williams

In addition, I have held research assistant positions for Glenn Ellison and Neil Thompson.

Research Interests

My research interest can broadly be described as understanding how technological change influences innovation and strategy in firms. Specifically, below is one research project I have ongoing with Neil Thompson. We are currently in negotiations with Microsoft to provide data for our empirical analysis.

How is Cloud Computing changing the pace of innovation?

Cloud Computing is changing how innovation takes place in the economy. We already know Cloud Computing is an important economic activity; IDC predicts the cloud services industry that supplies Cloud Computing to other companies will generate \$100 billion in sales by 2017.¹ However, Cloud Computing's broader impact will be much larger. We have seen the entertainment industry upended by Netflix, the media industry redefined by Google and retail reshaped by Amazon. These changes go beyond the types of distribution disruptions enabled by the Internet; firms are innovating in ways that were not possible before. For example, startups with few resources can comb

¹ <http://www.networkworld.com/article/2175333/cloud-computing/idc--cloud-will-be--107b-industry-by-2017.html>

large genetic databases for disease markers to bring new products to market, a task that was only possible at major research institutions prior to Cloud Computing.²

Based on interviews with Cloud Computing providers and users over the past six months, we see the following arguments proposed as the reasons for why Cloud Computing is enabling new innovations:

1. **Cheaper computing:** Cloud providers can take advantage of economies of scale in hardware, power, and system administration to drive computing costs lower than individual firms can.
2. **Switch from fixed to variable costs:** Previously firms had to make large up-front investments to grow or experiment, discouraging both activities. Now firms can do this at a low initial marginal cost.
3. **Increased capabilities:** Cloud providers can better integrate tools, giving (particularly small) businesses the ability to do new types of tasks. This may be particularly valuable for tasks that require rare skills, for which many firms might have trouble hiring.

However even these claims about cost effectiveness and capabilities are controversial:

- According to industry experts, once the cost of using a public cloud provider gets above a few thousand dollars per month, cost effectiveness actually favors in-house servers.³
- A single machine can run certain tasks faster than hundreds of Cloud Computing machines clustered together⁴

Testing the veracity of these claims on benefits of Cloud Computing can help us understand the changing nature of innovation. Among the key questions are:

- Are firms using Cloud Computing to bring innovative new products to market? For example, Siri would not be computationally (nor power) feasible on mobile phones were it not for the ability to push computations to the Cloud. Cloud computing pushes out the technological frontier, relaxing the constraint on what is possible.
- Is the increased innovation a result of increased experimentation? In the past, firms would have to ex ante budget and build for large audiences with any small experiment in case their product was successful. Now firms can scale on demand, lowering the cost to experiment.
- Have startups been empowered to bring new innovation to markets? In the past, only the largest firms had the capital necessary to pay the upfront costs of associated with owning large datacenters and entering some markets. Today capital-constrained firms can take advantage of Google or Amazon's computation scale with little initial investment, changing the competitive landscape in many industries.
- Are "cloud native" firms the ones driving the increased innovation? Many established business practices have become either irrelevant or greatly revised because of Cloud Computing. Firms grounded in those practices will not gain as much from Cloud Computing relative to firms organized around cloud optimal routines.

² <http://bits.blogs.nytimes.com/2014/06/11/the-era-of-cloud-computing/>

³ See <http://www.wired.com/2013/08/memsql-and-amazon/> and <https://blippex.github.io/updates/2013/09/23/why-we-moved-away-from-aws.html> for examples

⁴ McSherry, Frank, Michael Isard, and Derek G. Murray. "Scalability! But at what COST." 15th Workshop on Hot Topics in Operating Systems (HotOS XV). USENIX Association, 2015.