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Admissions Committee
NBER Digitization Tutorial 2020

Subject: Application to NBER Digitization Tutorial 2020

Nov 4, 2019

Dear Sir/Madam,

I am writing to you to apply to the *NBER Digitization Tutorial 2020*, for which I believe I would be an excellent fit due to the nature of my research (which focusses almost exclusively on the effect of digitization on classic questions in industrial organization such as price competition and efficient procurement). Please find below the requested details.

Contact Information.

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Graduate Studies. I am a fourth year PhD student at Princeton (enrolled since 2016), and also have an MPhil in economics from Oxford (Nuffield College; 2014-2016) as well as a BA in Philosophy, Politics and Economics from Oxford (2011-2014). On top of the classic first-year coursework (micro, macro, metrics), which I completed at both institutions, my graduate coursework focussed on:

- Industrial Organization
  - IO 1: Theory (Oxford; Mark Armstrong & Simon Cowan)
  - IO 2: Empirical (Oxford; Howard Smith)
  - IO 3: Network & Selection Markets (Oxford; Andre Veiga)
  - Industrial Organization I (Princeton; Jakub Kastl and Nick Buchholz)
  - Industrial Organization II (Princeton; Jakub Kastl and Adam Kapor)
- Microeconomic Theory
  - Advanced Microeconomics I (Oxford; Margaret Meyer, Yuval Heller & Peyton Young)
  - Advanced Microeconomics II (Oxford; Adrien Vigier)

  - Advanced Economic Theory I (Princeton; Leeat Yariv & Pietro Ortoleva)
  - Game Theory (Princeton; Juan Pablo Xandri Antuna)
  - Decision Theory (Princeton; David Dillenberger)
- Political Economy
  - Political Economy I (Princeton; Thomas Romer)
  - Political Economy II (Princeton; Matias Iaryczower)
- Advanced Macroeconomics I (Oxford; Chris Bowdler & Basile Grassi)
- Advanced Econometrics I (Oxford; Bond & Duffy)

I sat my field exams at Princeton in Industrial Organization and Microeconomic Theory. I am also currently working towards the Graduate Certificate in Machine Learning and have taken the "Fundamentals of Machine Learning" class in the CS department towards this requirement.

Research Interests. My (primary) supervisor is Jakub Kastl, and my main research area is industrial organization. More concretely, I am interested in how digitization shapes economic incentives in classic industrial organization settings such as price competition, mediation of competition via platforms and efficient procurement. I also have a secondary research interest in questions of political economy such as vote buying. Please find below titles and extended abstracts for my current working papers.

- **Algorithmic Pricing Facilitates Tacit Collusion: Evidence from E-Commerce.**
  (This paper won the third-year paper prize of the Princeton Economics Department.)
  As the advance of the digital age is lowering menu costs across all sectors of the economy, it is becoming increasingly important to study how firms' ability to update prices more and more frequently is affecting the nature of competition between them. While there is an extensive theoretical literature on dynamic games, the Folk Theorem warns us that the predictive power of equilibrium reasoning is extremely limited in dynamic environments with brief periods. Hence, empirical research into the issue of repricing is necessary.

  This paper employs extensive data on the pricing decisions made by third-party sellers on a well-known e-commerce platform to empirically assess and expand the theoretical predictions of the literature on dynamic pricing. We find that delegation of pricing to simple algorithms has the potential to facilitate tacit collusion by reducing the set of available strategies. Furthermore, the algorithms currently employed are significantly simpler than the Markov-perfect strategies of Maskin and Tirole (1988) and emerge naturally as the result of a best-response process once the ability to regularly reprice is introduced into the marketplace. We build a model that suggests that if this best-response process were allowed to play out without intervention, the market would fully transition from static to dynamic pricing. Along the transition path, prices initially fall, but eventually rise dramatically. However, the marketplace we examine has only just begun its way on this transition path.

  We argue that cycling patters we see in our data lack several of the classic features of Edgeworth cycles and are more consistent with our model of 'delegated strategies'. Inverting this model to marginal costs, we conclude that welfare under automated repricing is comparable to welfare under monopoly pricing.

- **Mediating Competition on an Online Platform.** *(with Kwok-Hao Lee)*
  As an increasing number of market transactions are intermediated by various technology companies using online platforms, we have seen an increasing interest in examining the extent to which these platforms can exploit their intermediation decisions to cement their market power and/or influence competition. This paper is concerned with one specific intermediation technology: the Amazon 'Buybox' algorithm which assigns sales to merchants on the third-party marketplace.

  In our reduced form analysis, we find that sellers' likelihood of reaching the Buybox depends on multiple criteria, the most important of which is perhaps unsuprisingly the price they charge. However, relative to variables observable to us, Amazon also seems to be giving its own offers an advantage equivalent to a 16.9% decrease in prices. Similarly, merchants that employ Amazons' in-house fulfillment service FBA are given an advantage equivalent to a 10.9% price discount. However, perhaps most interestingly, we find that

Amazon seems to rotate the Buybox, i.e. even with fixed offer-characteristics, the Buybox seller identity changes over time.

Motivated by these rotations, we build a structural model in which merchants make entry decisions anticipating the strength of competition as induced by the extent of the randomization. We explore counterfactuals under which Amazon increases or decreases the extent of randomization and conclude that Amazon's main incentive in randomizing is to incentivize entry in the presence of fixed costs and high merchant turnover.

- **Collusion-Proof Vote Buying.** *(with Charles Louis-Sidois)*
  We study the problem of a vote buyer who wants to influence the vote of a committee the members of which can coordinate on their preferred equilibrium. We characterize the optimal bribes under different voting setups. The vote buyer seeks the support of a supermajority because members do not expect to be pivotal and accept small bribes in exchange for their vote. We discuss the committee design that maximizes cost of capture: demanding majority requirements combined with diversity among members make the committee more expensive. Meanwhile, larger committees, transparent voting rules and sequential voting can lower the bribing cost.

  While this work is less related to digitization than my other projects, the increase in the number of elections conducted online (i.e. with less oversight and face-to-face interactions) has arguably made vote-buying an easier endeavour. In particular, the advent of 'smart contracts' such as those available on Ethereum for the first time allows would-be vote buyers to credibly commit to a bribing strategy.

- **Digitizing Procurement.** *(with Bruno Baranek, Vita Titl and Andrey Tkachenko)*
  This very early-stage project is concerned with the recent revolutions in procurement that have taken place initially in the Ukraine and subsequently in Moldova and Georgia. Using open-source technology initially developed by an NGO, these countries have all adopted (slight variations of) e-procurement platforms based on the OpenProcurement project. Against the background of high corruption rates, these platforms for the first time make open access to procurement data a cornerstone of their approach by publishing information on all bidders, bids, and signed contracts online. Going even further, several of these platforms provide a fully public complaints process, automatic 'red flag' checks for suspicious contracts and an interface using which all participants in procurement can publicly provide reviews of their counterparties' handling of a specific tender.

  We are currently discussing data access with the creators of the OpenProcurement toolkit. We are planning on evaluating the extent to which the increase in transparency brought about by the e-procurement revolution has led to lower tender costs and changes in indicators of collusive behavior. We are particularly interested to see whether more obvious collusion (such as obtaining only one bid for a tender) has been replaced by competitive behaviour or merely by more sophisticated collusive techniques (such as the submission of fluff bids).

As you can see from these extended abstracts, the key focus of a vast majority of my ongoing research projects is to examine the impact that digitization has had on various marketplaces: how has the introduction of a re-pricing API on Amazon Marketplace influenced the quality of competition between merchants? To what extent can online platforms exploit their intermediation decisions to shape competition between themselves and third parties? Does the increased transparency and oversight functionality of e-procurement platforms translate into substantially lower procurement costs? The answers to these research questions speak to the more general influence that digitization has had and will have on our economy.

Best wishes,

Leon Musolff