Minhae Kim, NBER Digitization Tutorial Application

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- 4th year PhD student in economics at The Ohio State University
- Primary fields
  - Empirical Industrial Organization, Econometrics, Applied Microeconomics
- Graduate courses taken (selected)
  - Empirical Industrial Organization (Javier Donna/Matthew Weinberg)
  - Theoretical Industrial Organization (Huanxing Yi)
  - Computational Econometric Methods in Applied Microeconomics (Adam Dearing): Computational methods used in estimation of structural discrete choice models
  - Applied Econometrics (Daeho Kim): Identification and estimation issues in empirical economic research, particularly labor, health, and population economics
  - Advanced Econometrics (Mehmet Caner): High dimensional econometrics
  - Advanced Econometrics (Lung-fei Lee): Spatial econometrics
  - Advanced Econometrics (Jason Blevins): Methods in microeconometrics including nonparametric methods and estimation of structural models
- Committee members (for candidacy exam scheduled in Spring, 2020)
  - Jason Blevins (chair), Matthew Weinberg, Adam Dearing, Javier Donna
- Research Interests and working papers

  My primary research areas are Empirical Industrial Organization, Econometrics, and Applied Microeconomics. I am particularly interested in estimating dynamic structural models and developing estimation methods. Currently I have three papers in progress and two of them explore the effects of the internet on brick-and-mortar bank branches using different models.

Federal Deposit Insurance Corporation's survey on economic inclusion (2018) shows that there still exist consumers, especially in low income households, who use a bank branch as their primary method to access their account. This fact shows that bank branches still matter, and my research can help to quantify the effect of the internet on bank branches.

My first paper, **"Does the Internet Replace Brick-and-Mortar Bank Branches?"**, develops a dynamic discrete game in continuous time to examine the effects of the internet on banks' per branch profit. Summary of Deposits, provided by Federal Deposit Insurance Corporation, includes a list of U.S. bank branches and their opening dates. The dates are spread throughout the year which means that a continuous time model with stochastic decision times fit the data better. Using a panel data set during 2008–2017, I develop a discrete choice game in continuous time for three large U.S. banks. Banks solve an instantaneous Bellman equation based on their expectations about other banks' branch openings, closures, and changes in other state variables including the number of internet connections and population in a market. To estimate the model, this paper applies the nested pseudo likelihood (NPL) estimator, which is a novel estimator in continuous time introduced, in my another ongoing research. It does not require consistent initial choice probabilities and is known to be more efficient than previously introduced two-step estimator in continuous time. The estimation results imply that more internet connections can reduce banks' profit generated per branch.

The next paper, **"Effects of Community Connect Broadband Grants Program on Bank Branches"**, also focuses on the impact of the internet in retail banking sector, by estimating how the internet subsidy affected the number of bank branches in rural areas. Community Connect Broadband Grants program was created in 2002 to provide financial assistance in the form of grants to eligible applicants that will provide broadband service. I develop an event study model to the effect of this subsidy on internet establishment on the number of bank branches from 1994 to 2017. I find that receiving benefits from this program decreases the number of bank branches.

Lastly, I also have worked on developing estimators to estimate dynamic discrete choice models in continuous time which was used for my first paper. In a cowork with Jason Blevins, **"Nested Pseudo Likelihood Estimation of Continuous-Time Dynamic Discrete Games"**, we introduce a sequential estimation algorithm to estimate dynamic discrete choice models in continuous time. Dynamic discrete choice models have been used in various areas including dynamic demand models and firm entry-exit models which are mostly developed

in discrete time setting. We extend the nested pseudo likelihood estimator introduced by Aguirregabiria and Mira (2002, 2007) to continuous time models to better approximate the reality in certain economic contexts and to lessen the computational burden. We find that the NPL estimator in continuous time models has satisfying large sample properties as in discrete time models. Moreover, we present the local convergence condition in the iterative NPL algorithm and the zero Jacobian property assuring the local convergence in single agent models. Monte Carlo experiments using a five-player dynamic discrete game are executed to show the relative efficiency of the NPL estimator compared to two-step estimators.

In the future, I am planning to continue my research on developing models and examining the effects of adding online channels to offline channels in banking industry.