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Research Statement

My primary research areas include empirical industrial organization and health economics. I also have secondary interests at the intersection of applied microeconomics, machine learning tools, and applied econometrics. My research agenda includes three areas: (1) understanding the role of firms' behaviors in shaping economic and health outcomes, (2) studying anti-trust policies and issues, and (3) developing econometrics tools to better understand these research questions. I extensively use both reduced-form and structural models to answer my research questions.

Research on the effect of firms' behaviors on economic/health outcomes

My job market paper "**Rural Pharmacy Access and Competition: Static Games with Machine Learning**" provides the first empirical evidence that the new entries of chain pharmacies have led to a large decline in the number of independent pharmacies from nearby rural towns in the Midwestern United States. Chain pharmacies are more likely to be in urban areas and shopping malls with higher demand, leading to more limited pharmacy access in nearby rural towns, which are typically distant from urban areas.

To decompose the competition effects from chain pharmacies and rival independent pharmacies, I model independent pharmacies' entries and exits as a static game of incomplete information. To allow for a data-driven selection of various market characteristics in independent pharmacy profits, I integrate machine learning into popular structural game models. While I do not observe the true coefficient, the magnitude of the rival independent pharmacy effect on profit is 50% larger using my developed methodologies than using the conventional method. This difference arises from the fact that machine learning can accommodate nonparametric flexible functional forms, thereby enhancing the predictive power of the rival's entry choice probabilities. Having these structural estimates, I conduct counterfactuals to shed light on the role of chain pharmacies as well as policy intervention to improve pharmacy access. My first counterfactual simulation documents the role of chain pharmacies in that new entries of chain pharmacies could explain 40% of the closures among independent pharmacies from 2000 to 2019. Second, my policy experiment evaluates the effect of a proposed subsidy program on improving limited pharmacy access, such as a physician bonus program for Medicare-related services that targets areas with limited medical access. The analysis shows that when such a policy is implemented, 16% of rural towns previously identified as having restricted pharmacy access would no longer be categorized as such.

Research on anti-trust

I am also interested in understanding the importance of anti-trust issues and anti-competitive behaviors. In a project entitled **"Horizontal Merger and Post-Entry Behaviors: Evidence from Acquisition in the Retail Pharmacy Market,"** I provide the first causal evidence for the effect of the horizontal merger on post-entry behaviors. My research is motivated by the

Horizontal Guidelines, issued by the Department of Justice and the Federal Trade Commission. These guidelines state that regulatory agencies should evaluate whether entry after a merger would be timely, likely, and enough to offset any negative impacts on competition. The relevant research question is if a horizontal merger of dominant firms reduces competition, does it also make it easier for new firms to enter the market, preventing any major decrease in competition?

To empirically address this, I turn to the heated discussions surrounding the approved horizontal merger between Walgreens and Rite Aid in 2018, with Walgreens and Rite Aid holding the first and third ranks in market shares, respectively. This brought anti-trust concerns as mergers between dominant firms might harm competition and decrease consumer welfare. Using staggered difference-in-differences estimation, I find that horizontal mergers are associated with a decrease of 0.6 units (17%) in the total number of stores. Moreover, I do not find causal evidence that horizontal mergers lead to new market entry by non-merging competitors. These findings challenge the claim by merging firms that any decrease in competition from a merger would be offset by new market entry. For antitrust policy, these results suggest that antitrust policymakers might need to review proposed horizontal mergers more carefully to address antitrust concerns, taking potential market entry into account as well.

In a paper titled "**Estimating Switching Costs for Telecommunication Services and Bundles**," accepted by *Applied Economics* and co-authored with Hyunchul Kim (Sungkyunkwan University), we develop a consumer-level demand model for comprehensive telecommunications and broadcasting services, including bundled services. Recently, sellers have offered more bundled packages rather than individual services. While these bundles offer savings, they might disadvantage consumers by imposing additional switching costs when they want to subscribe to services from a new provider. Given that switching costs can lead to deterioration in the market efficiency – as service providers exploit consumers by locking them into long-term bundle subscriptions – bundling often raises antitrust concerns. To understand the role of switching costs, we estimate the switching costs associated with bundling. Previous research has mainly looked at the choice of just one or two services, neglecting the interplay among various services made feasible by bundling. Our methodology enhances the precise estimates of switching costs by allowing for more comprehensive choice sets, especially when compared to the models with limited choice sets. We find that the switching costs related to bundling are significant, accounting for roughly 65% of the monthly service expenses. Implementing policies that reduce these switching costs could foster a more competitive environment.

Future Work

After the job search, I will split my job market paper into two projects as my paper has both empirical contributions to health economics literature and methodological contributions in the field of econometrics and machine learning. The first paper focuses on pharmacy access in high elderly population towns and evaluates a government policy to improve pharmacy accessibility in these towns. The second paper will focus on the development of the game theoretic models with many covariates, as this is the first paper in the literature that combines a structural approach with machine learning methods providing valid inferences.

Going forward, I would like to continue working on multiple projects closely related to my job market paper, the welfare effect of health policy and the development of machine learning tools in structural methods.

First, as a direct follow-up, I am particularly interested in the welfare analysis of limited pharmacy access. Anecdotal evidence suggests mixed predictions that the elderly population might lose the most consumer welfare because they might face difficulty in visiting further away pharmacies due to higher transportation costs. At the same time, consumers might benefit from competitive pricing from chain pharmacies with higher-quality services. Structural demand/supply estimation in prescription pharmacies will reveal consumers' preferences over transportation costs, pharmacy types, and supply-side profit functions. The model also allows me to document the welfare changes of consumers and suppliers after chain pharmacies enter the market.

Armed with the demand and supply side parameters, this future paper can propose and compare various government interventions, including reimbursement programs like physician bonus programs, pharmacy student loan programs in rural areas, and subsidies for entry costs. As the structural analysis does not require post-policy analysis, the welfare analysis will inform policymakers as to which policy is the most cost-efficient to improve health inequality with low costs.

Related to my ongoing interest in incorporating machine learning into structural methods, Arie Beresteanu (University of Pittsburgh) and I study the development of econometric models for dynamic games with many covariates, building off my job market paper. This is an even more challenging task compared to static games, as dynamic games further require the removal of biases associated with the evolution of future states, in addition to competitors' behaviors. Given that dynamic games can capture sunk costs and forward-looking behaviors, and many industries fall into the dynamic games category (e.g., R&D, patents, manufacturing), this tool is a key methodology in empirical industrial organization. As there is a greater interest in combining structural models with machine learning in the field of industrial organization, we are excited to apply them to shed light on the understanding of firms' behaviors and their effects on economic outcomes.