Application to the NBER Digital Economics and AI Tutorial
January 20–21, 2027 — Stanford University

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Graduate Study

I am a fourth-year Ph.D. candidate in Economics at Stanford University, where I have been enrolled since Fall 2023. My research focuses on microeconomic theory, particularly mechanism and market design, auction theory, and the robustness of economic institutions to collusion and other forms of strategic behavior.

Before joining Stanford, I studied mathematics and physics at École Polytechnique and completed master's degrees in Statistics and Machine Learning at ENSAE and in Economics at Institut Polytechnique de Paris/HEC Paris. This background has led me toward theoretical questions at the intersection of economics, game theory, and the design of markets and institutions, and make me well prepared to gain the most from the tutorial.

Research Statement

At Stanford, my research has concentrated on understanding when familiar conclusions from mechanism design continue to hold once one moves beyond the standard model in which agents act independently, and deviations are considered one agent at a time. I am particularly interested in environments in which participants can coordinate, institutions may be vulnerable to manipulation or corruption, and the designer does not have a precise model of the strategic arrangements that agents can form.

In The Limits of Auctions under Ex-Ante Collusion, joint with Ravi Jagadeesan and Ilya (**R&R at Econometrica**), we study revenue-maximizing auction design when bidders may collude before learning their values or deciding whether to participate. We show that private information does not by itself prevent bidders from coordinating efficiently. Therefore, a seller cannot guarantee more expected revenue than an optimal posted price with rationing. At the same time, simple posted pricing can be vulnerable to inefficient collusion. We construct mechanisms that preserve the posted-price revenue guarantee against a broad class of possible collusive arrangements. More generally, the paper develops a notion of robustness that does not require the designer to specify exactly which coalitions can form or what information and commitment technologies they possess. A related project, Robustly Efficient Implementation under Collusion: Holdout Threats and the Anti-Core, also joint with Ravi Jagadeesan and Ilya Segal, asks when first-best welfare can be implemented robustly when coalitions can coordinate and agents have property rights that allow them to refuse participation. We characterize first-best implementability through the non-emptiness of the "anti-core" associated with the underlying cooperative game and characterize both second-best welfare guarantees and the subsidies required to achieve first-best implementation. These projects are part of a broader interest in

designing institutions that remain effective without relying heavily on assumptions about which forms of coordination among participants are feasible.

In Corruption in Auctions: A Foundation for the Second-Price and Dutch Auctions, joint with Tatul Ayrapetyan (**Extended Abstract at EC'27**), we consider an auctioneer who operates an auction on behalf of a principal but may secretly cooperate with bidders to extract rents. We introduce a measure of an auction's robustness to corruption based on the minimum size of a coalition required to implement a profitable manipulation while maintaining an innocent explanation for outsiders. Within a natural class of optimal auctions, the analysis gives a corruption-robustness rationale for familiar formats and highlights a sharp distinction between second price and Dutch auctions.

My other current work explores complementary departures from standard mechanism-design assumptions. Mechanism Design with Risk-Aversion: A Theory of the First-Best studies efficient mechanism design when agents are risk-averse so that the allocation of both social surplus and risk matters to them. A mechanism is first-best if it lies on the Pareto-frontier of the set of interim certainty equivalents for the agents and the designer's net expected payoff, the latter acting as a monetary sink. This criterion is shown to be equivalent to a mechanism being full insurance for the agents and having an ex-post efficient outcome rule. Both ex-post budget balance and dominant-strategy incentive compatibility are generically incompatible with a mechanism being first-best. An (interim) incentive-compatible first-best mechanism is constructed, for a general social problem in which types can be multidimensional, and agents can exhibit arbitrary (weakly) risk-averse preferences. Ex-Ante Individually Rational Trade, joint with Ravi Jagadeesan (**R&R at AEJ: Micro***)*, studies the implications of imposing participation constraints at the ex-ante rather than ex-post or interim stage.

Interest in Digital Economics and Artificial Intelligence

I am interested in *AI both as an object of economic analysis and, especially, as a potential tool for advancing economic theory.*

A large part of modern microeconomic theory consists of problems for which the underlying optimization or equilibrium system is well defined, but a useful characterization remains out of reach. Mechanism design provides many examples. In one-dimensional screening and auction problems, strong structural results reduce apparently infinite-dimensional design problems to tractable characterizations. In multidimensional screening and multidimensional auctions, by contrast, comparably general results are scarce, and much of what is known relies on special distributions, geometries, or preference structures. I am particularly interested in whether modern AI methods can help make progress on such problems. For example, one could use computational methods to search over mechanisms in high-dimensional environments, detect qualitative regularities across numerical solutions, generate conjectures about the geometry of optimal allocation regions or payment rules, and then translate those conjectures into mathematical statements that can be proved analytically. More ambitiously, AI systems may eventually become useful collaborators in the process of theoretical discovery itself: exploring large spaces of examples, proposing candidate lemmas or counterexamples, or identifying transformations that expose hidden structure in a difficult problem. Multidimensional mechanism design is a particularly appealing test case because the gap between the elegance of the one-dimensional theory and our limited understanding of the general multidimensional problem is so

large. Similar questions arise in robust mechanism design, where the designer may need to optimize against large classes of deviations, information structures, or coalition technologies.

AI also raises substantive mechanism-design questions. Digital markets are increasingly populated by participants who use sophisticated algorithms to search, price, bid, and negotiate. As these tools become more capable, assumptions about bounded strategic sophistication, independent optimization, and the feasible forms of coordination may become less plausible. This creates a natural connection to my work on collusion and robustness: which mechanisms continue to perform well when agents become better at identifying profitable deviations, and how should market institutions be designed when the strategic capabilities of participants are themselves evolving?

The NBER Digital Economics and AI Tutorial would therefore be valuable to me in two complementary ways. First, I would like to learn more about the economic consequences of AI for platforms, competition, pricing, information, and market design. Second, I would like to understand how researchers are using modern AI and computational methods as inputs into economic research, and whether these tools can be adapted to attack difficult open problems in microeconomic theory. The opportunity to discuss these questions with researchers working at the frontier of digital economics and AI, and to attend the subsequent NBER meetings, would be especially useful as I develop the next stage of my research agenda. I would be very grateful for the opportunity to participate in the tutorial.