Research Statement—*Mohammad Akbarpour, Stanford University*

My research is defined broadly by questions of market design and network theory. Within these fields I investigate subjects as disparate as auctions, dynamic matching, kidney markets, redistributive policies, and diffusion in networks. Methodologically, some of my work is distinguished by applying an "algorithmic" perspective that, instead of (over)simplifying the models to make them tractable, includes first-order complexities and characterizes *near-optimal* solutions, which enables me to identify key features of the *exact optimum.* Below, I summarize the four branches of my research agenda.

I. Auction Market Design: Credibility and Computational Complexity

Since taking my first mechanism design class, I was puzzled by the question of *who guards the guardian*? The so-called "revelation principle" sets aside the possibility of an auctioneer deviating from the rules of the game by focusing on direct mechanisms. But what if the auctioneer is corrupt? This question is where my paper *"Credible Auctions: A Trilemma"* [1] (*Econometrica*, 2020) was born. We consider a setting where the auctioneer can deviate from the rules, subject to not being detected by any bidder, saying that a mechanism is *credible* if it is incentive-compatible for the auctioneer to follow the rules. For instance, the sealed-bid second-price auction is not credible, because the auctioneer can exaggerate the second highest bid without being detected.

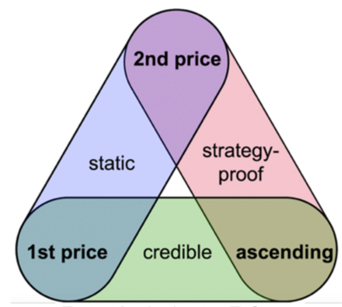

Figure 1 - An Auction Trilemma

Applying this definition to the setting of optimal auctions helps us answer a classic auction theory question: *what accounts for the popularity of the first price and ascending auctions?* This is especially puzzling when we note that the first-price auction requires complex strategizing and the ascending auction requires many rounds of communications, whereas William Vickrey's ingenious second-price auction is nonetheless strategically and logistically simple. We show that credibility is the shared feature of the first-price and ascending auctions; in both, *the mechanism* guards the guardian! In fact, credibility turned out to be more fundamental than what we imagined: The first-price auction is the unique static, credible optimal auction and the ascending auction is the unique strategy-proof, credible one! Together with the classic Green-Laffont-Holmström result, this leads to an auction trilemma, fully characterizing the three most common practical auctions. (Figure 1 illustrates.)

My second auction theory paper [2] (R&R, *Econometrica*) is concerned with investment incentives of mechanisms in computationally complex settings where practitioners use approximate algorithms to determine who gets what. We show that approximate mechanisms that are nearly—but not exactly—optimal can lead to poor performance when participants have investment opportunities. However, if a near-optimal algorithm "excludes bossy negative externalities," (XBONE) then its outcomes remain near-optimal even after accounting for investments. Thus, in settings where investment opportunities are economically significant, XBONE can be used as a design criterion.

II. Matching Market Design: Timing, Tokens, and Taboos

Every year, thousands of kidney patients die, and dialysis costs are about 1% of the entire U.S. federal budget. My second research agenda is around finding solutions that save lives by increasing the supply of kidneys, or improving their allocative efficiency.

In my PhD years, I observed that kidney exchange algorithms tend to be evaluated based on their performance on given sets of patient-donor pairs, even though the way the pool of pairs evolves over time also depends on the algorithm. In my job market paper [3] (*JPE,* 2020), we show that matching algorithms that take into account this endogeneity, and thus optimize for *when* to match—in addition to the static question of *who* to match—can potentially match many more patients-donor pairs. Algorithms designed in this paper were—unexpectedly—picked up by some researchers working on data from DiDi ridesharing platform [4]. Inspired by this, in a new paper [5], we prove that in spatial markets, mild excess supply can substantially improve performance, and even naïve, greedy algorithms can realize these gains.

In a second dynamic kidney exchange paper [6] (forthcoming, *PNAS*), we propose a new design—*global kidney chains*—which helps patients in poor countries receive transplants by participating in an American kidney chain. We prove that savings to the U.S. are more than enough to cover foreign patients' costs. My third kidney paper [7] (R&R, *Restud)* introduces an algorithm based on *kidney tokens* to break the problem of double coincidence of wants. Our counterfactual analysis on the French kidney data shows that our algorithm substantially outperforms the state-of-the-art.

While kidney exchange is a poster child of success in market design, the total number of transplants facilitated by kidney exchange is less than 2.5% of the kidney demand. As such, many are now asking: Is it time to legalize kidney sales? In [8] (R&R, *JPE*), we collect six years of data from the *only* legal market for kidneys in the world in Iran and find that the market has substantially increased the supply of kidneys. Simple welfare calculations show that a market for kidneys can increase U.S. patients' lifetime by about 7 years and save taxpayers more than $6 billion per year. Of course, there are many ethical concerns associated with this market, some of which we investigate through the lens of our data.

III. Redistributive Market Design: Prices, Priorities, and Probabilistic Allocations

The third branch of my research agenda is on the border of mechanism design and optimal taxation. In "*Redistribution through Markets"* [9] (*Econometrica, 2021*), we reexamine the very standard Econ 101 market model from a utilitarian perspective in which individuals have different marginal values for money. We prove that if agents' values are privately known, then the 2nd welfare theorem does not apply, and there is a sharp trade-off between efficiency and redistribution. Our findings show that with low inequality, market equilibrium remains optimal, but when there is significant inequality in values for money, it may be optimal to impose price controls even though doing so induces rationing.

Three other papers build on this main idea: The first one [10] (R&R, *JPE*) studies the problem of prices versus priorities in the allocation of heterogeneous objects and identifies when and why priorities and lotteries are superior to prices. The second paper [11] applies the results of this paper into the problem of vaccine allocation and fully characterizes the optimal allocation scheme. I am also working on a paper that investigates when and why *queuing* (costly waiting) is superior to prices or rationing.

I have two other papers inspired by distributional considerations. The first one [12] (*Restud,* 2020) tackles a market design impossibility result. It is known from prior work that with *intersecting constraints* in a matching problem (e.g., a school choice setting with both walk-zone and socioeconomic status quotas) it is in general impossible to find a fair lottery that satisfies all constraints [13]. We prove that if some constraints are *soft* in the sense that they can bear a small error with little cost, then intersecting constraints can be handled.

The second paper [14] (R&R, *Journal of Public Economics*) is on school choice with unequal outside options (e.g. private schools). We prove that in non-strategy-proof mechanisms, students with access to *private* schools are more likely to get into the top *public* schools, because they can afford to apply to riskier schools. Strategy-proof (SP) mechanisms, however, level the playing field for all. We validate the theoretical predictions by identifying a natural experiment in New Haven's school choice. This provides a new, inequality-based argument in favor of SP mechanisms.

IV. Network Diffusion, Random Seeds, and Pandemic Policy Response

Finally, I have been working on questions on the intersection of network theory and policy. Perhaps most importantly, in *"Just a Few Seeds More"* [15] (R&R, *AER*), we study the problem of how to identify individuals who are the best 'seeds' for maximizing the spread of information in a social network. This is a widely studied problem in development economics, marketing, and health policy. The main result of the paper proves that under a wide range of practically relevant conditions, seeding a slightly larger number of individuals *randomly* can prompt a larger cascade than seeding by optimizing over the network structure. We verify the results by using data from multiple development economics settings. In two other papers, I examine the impact of heterogeneous activity patterns and changing population on diffusion and learning [16, 17].

Tools and insights from these papers came back to me when the recent pandemic hit. I noted we can identify better lockdown policies *if* we have better network data. As such, with a large group of coauthors, we mixed several massive datasets to build the *human contact network* of different USA cities. Our results in [18] show that the optimal lockdown policies crucially depend on demographics and the network structure—a policy that can perform great in Chicago may not do so in Sacramento.[1]

REFERENCES

[1] Akbarpour, Mohammad, and Shengwu Li. "Credible auctions: a trilemma." *Econometrica*, March 2020.

[2] Akbarpour, Mohammad, Scott Duke Kominers, Shengwu Li, and Paul R. Milgrom. "Investment Incentives in Near-Optimal Mechanisms." Revise and resubmit at *Econometrica.*

[3] Akbarpour, Mohammad, Shengwu Li, and Shayan Oveis Gharan. "Thickness and information in dynamic matching markets." Journal of Political Economy 128, no. 3 (2020): 783-815.

[4] Liu, Tracy, Zhixi Wan, and Chenyu Yang. "The efficiency of a dynamic decentralized two-sided matching market." *Available at SSRN 3339394* (2019).

[5] Akbarpour, Mohammad, Yeganeh Alimohammadi, Shengwu Li, and Amin Saberi. "The value of excess supply in spatial matching markets." Working paper.

[6] Afshin Nikzad, Mohammad Akbarpour, Michael A. Rees, and Alvin E. Roth. "Global kidney chains". Accepted at the *Proceedings of the National Academy of Sciences*.

[7] Akbarpour, Mohammad, Julien Combe, Yinghua He, Victor Hiller, Robert Shimer, and Olivier Tercieux. "Unpaired kidney exchange: overcoming double coincidence of wants without money." Revise and resubmit at *Review of Economic Studies.*

[8] Akbarpour, Mohammad, Farshad Fatemi, and Negar Matoorian. "The Iranian market for kidneys." Stanford University Working Paper, 2020. Revise and resubmit at *Journal of Political Economy.*

[9] Dworczak, Piotr ® Scott Kominers ® Mohammad Akbarpour, "Redistribution through markets." *Econometrica,* July 2021.

[10] Akbarpour, Mohammad ® Piotr Dworczak ® Scott Kominers, "Redistributive allocation mechanisms." Revise and Resubmit at the *Journal of Political Economy.*

[11] Akbarpour, Mohammad ® Eric Budish ® Piotr Dworczak ® Scott Kominers, "An economic framework for vaccine prioritization." Working paper (2021).

[12] Akbarpour, Mohammad, and Afshin Nikzad. "Approximate random allocation mechanisms." *The Review of Economic Studies* 87, no. 6 (2020): 2473-2510.

[13] Budish, Eric, Yeon-Koo Che, Fuhito Kojima, and Paul Milgrom. "Designing random allocation mechanisms: Theory and applications." American economic review 103, no. 2 (2013): 585-623.

[14] Akbarpour, Mohammad, Adam Kapor, Chris Neilson, Winnie van Dijk, and Seth Zimmerman. "Centralized choice with unequal outside options." Working paper, 2020. Revise and resubmit at *Journal of Public Economics.*

[15] Akbarpour, Mohammad, Suraj Malladi, and Amin Saberi. "Just a few seeds more: Value of network information for diffusion." Working Paper, 2019. Revise and Resubmit at the *American Economic Review*.

[16] Akbarpour, Mohammad, and Matthew Jackson. "Diffusion in networks and the virtue of burstiness." In the *Proceedings of the National Academy of Sciences,* July 2018.

[17] Akbarpour, Mohammad, Amin Saberi, and Ali Shameli. "Social learning in overlapping generations." Working Paper, 2019. Selected as the **best paper** in WINE'18. Revise and resubmit at *Operations Research.*

[18] Akbarpour, Mohammad, Cody Cook, Aude Marzuoli, Simon Mongey, Abhishek Nagaraj, Matteo Saccarola, Pietro Tebaldi, Shoshana Vasserman, and Hanbin Yang. Socioeconomic network heterogeneity and pandemic policy response. No. w27374. National Bureau of Economic Research, 2020.

[1] We have also developed an interactive tool to identify optimal lockdown policies: https://reopenmappingproject.com/