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Berlin Social Science Center

The limits of markets and market design

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Workshop in honor of
Claude Montmarquette

CIRANO Montréal
April 2023

How do markets work?

- Many markets are simple:
You get what you want if you pay for it
- For some goods, you also have to be chosen:
 - Seats in schools and universities
 - Jobs
 - Kidneys
 - Partners

In matching markets, money does not determine who gets what.

Matching markets: Determining an allocation without money

- Performance/merit (universities, schools)
- Social criteria (schools)
- Medical criteria (organs)

Goods such as education and health are prerequisites of equal citizenship.

(T.H. Marshall, D. Satz)

Matching markets: A behavioral agenda

- False beliefs (misunderstanding the matching algorithm, over-/underconfidence)
Braun/Dwenger/Kübler (BEJEAP 2010); Braun/Dwenger/Kübler/Westkamp (GEB 2014);
[Dargnies/Hakimov/Kübler](#) (MS 2019, 2023)
- People have to form preferences over university programs etc.
Dwenger/Kübler/Weizsäcker (JPubE2018); [Grenet/He/Kübler](#) (JPE 2022);
Hakimov/Kübler/Pan (QE 2023)
- Repugnant transactions
[Erkut/Kübler](#) (2023)
- Preferences over matching mechanisms
König/Kübler/Mechtenberg/Schmacker (2023)
- Black market traders can profit from market design
[Hakimov/Heller/Kübler/Kurino](#) (AER 2021)
- Survey on matching experiments
Hakimov/Kübler (Exp Econ 2021)

Overview of the talk

Part 1: Which market exchanges are considered unacceptable?

- Should algorithms determine outcome of matching markets?
- Which transactions involving money should be prohibited?

Part 2: What limits market design?

- Are market participants' preferences fixed and known?
- Can it be avoided that “money seeps in” (Walzer)?

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Study 1

Aversion to hiring algorithms:
Transparency, gender profiling, and
self-confidence

Marie-Pierre Dagnies (Paris Dauphine)

Rustamdjan Hakimov (University of Lausanne)

Dorothea Kübler (WZB & Technische Universität Berlin)

Motivation

- Algorithms are employed in many matching markets, e.g., for school choice and university admissions, as well as hiring
- But many people are opposed to algorithms
- Potential welfare gains from using algorithms can be lost

→ Why are people opposed to algorithmic hiring?



Possible concerns regarding hiring algorithms

- Lack of [transparency](#)
- Workers fear [discrimination](#)
- [False beliefs](#) of managers about own ability:
“This myth of expertise results in an overreliance on intuition and a reluctance to undermine one’s own credibility by using a selection decision aid.” (Highhouse 2008)

Research questions



Workers' preference for hiring algorithms:

- Do [gender-profiling](#) and [lack of transparency](#) reduce the acceptance of algorithms?

Managers' delegation to hiring algorithms:

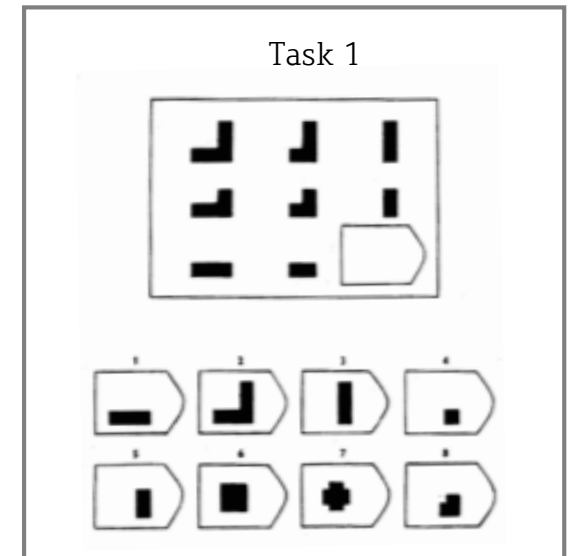
- Do [overconfidence](#) and [lack of transparency](#) hinder delegation to algorithms?

Experimental design

Workers solve three real-effort tasks (two min each), and are paid for one of them

- Task 1: Raven matrices
- Task 2: Counting zeros in grids (6x6)
- Task 3 (job task): Raven matrices and grids for counting zeros

[As we hoped for, workers' task-1 and task 2 performances as well as gender are correlated with performance in the job task.]

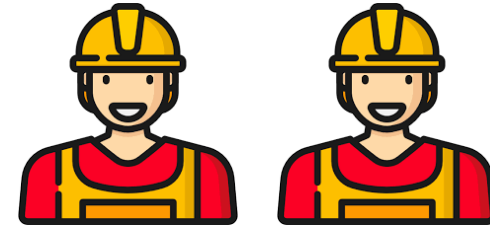


Task 2

0	1	1	0	0	0
0	1	0	0	0	1
1	0	1	0	1	0
0	1	1	0	0	0
0	1	0	0	0	1
0	1	0	1	1	1

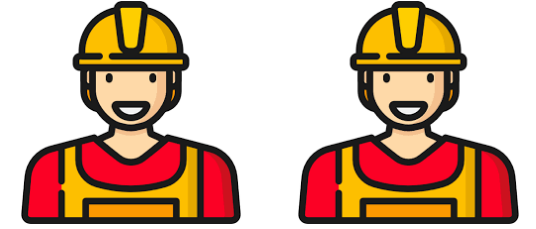
Experimental design

- Workers are paired randomly
- Manager and algorithm obtain a training set of workers with their gender, performance in tasks 1, 2, and job task
- Algorithm and manager choose one of the two workers after observing their **gender**, **task-1** and **task-2** performances
- Aim is to hire the worker with the **higher job-task performance**



[It turns out that algorithm makes more correct hiring decisions than managers: 66.9% versus 55.9% .]

Treatments for workers



- **BaselineW** – worker chooses whether algorithm or subject in the role of manager makes the hiring decision
- **NoGenderW** – as BaselineW but **algorithm does not use gender**, only task-1 and task-2 performance (managers can still use gender)
- **TranspW** – as BaselineW but with the following information:

“The algorithm calculates for at least 200 workers it has data on the mean relationship between the task-1 and task-2 performances and gender on the one hand and the task-3 performance on the other hand. This relationship is:

$$\text{“Task3} = 0.33 \cdot \text{Task1} + 0.39 \cdot \text{Task2} - 0.35 \cdot \text{Male} + 2.6$$

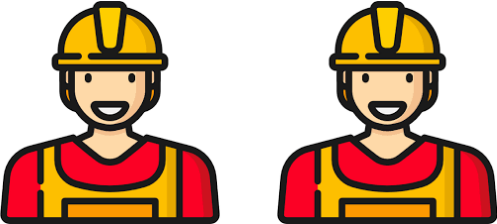
so that, in order to predict someone’s task-3 performance, one must replace, respectively, Task1 and Task2 with the task-1 and task-2 performances of the person and deduct 0.35 only if the participant is male.”

Treatments for managers

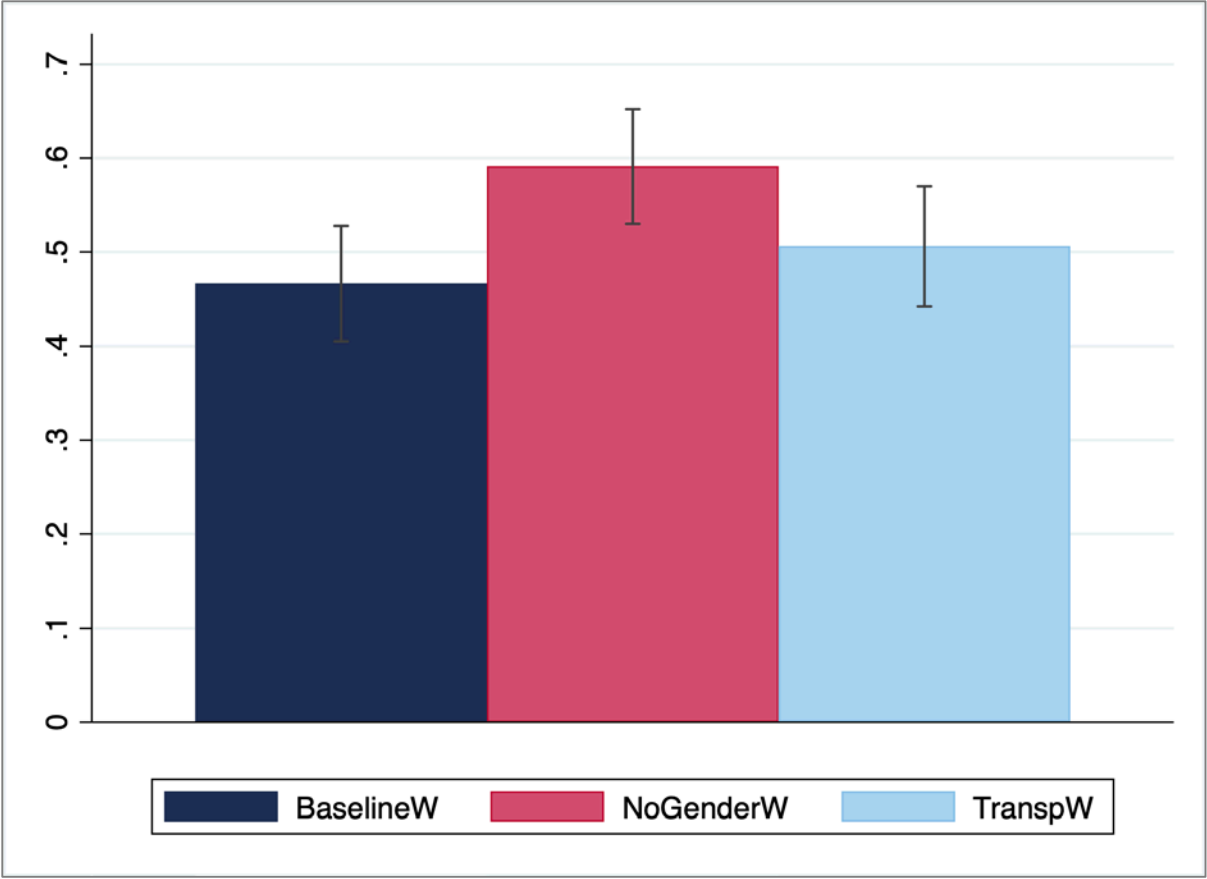


- **BaselineM** – manager makes 20 hiring decisions among pairs of workers, then chooses whether to delegate all decisions to algorithm
- **ConfidM** – as BaselineM but managers receive **feedback about correct hires** in the 20 decisions before delegation decision
- **TranspM** – as BaselineM but with the same information as in TranspW

Main results: Workers



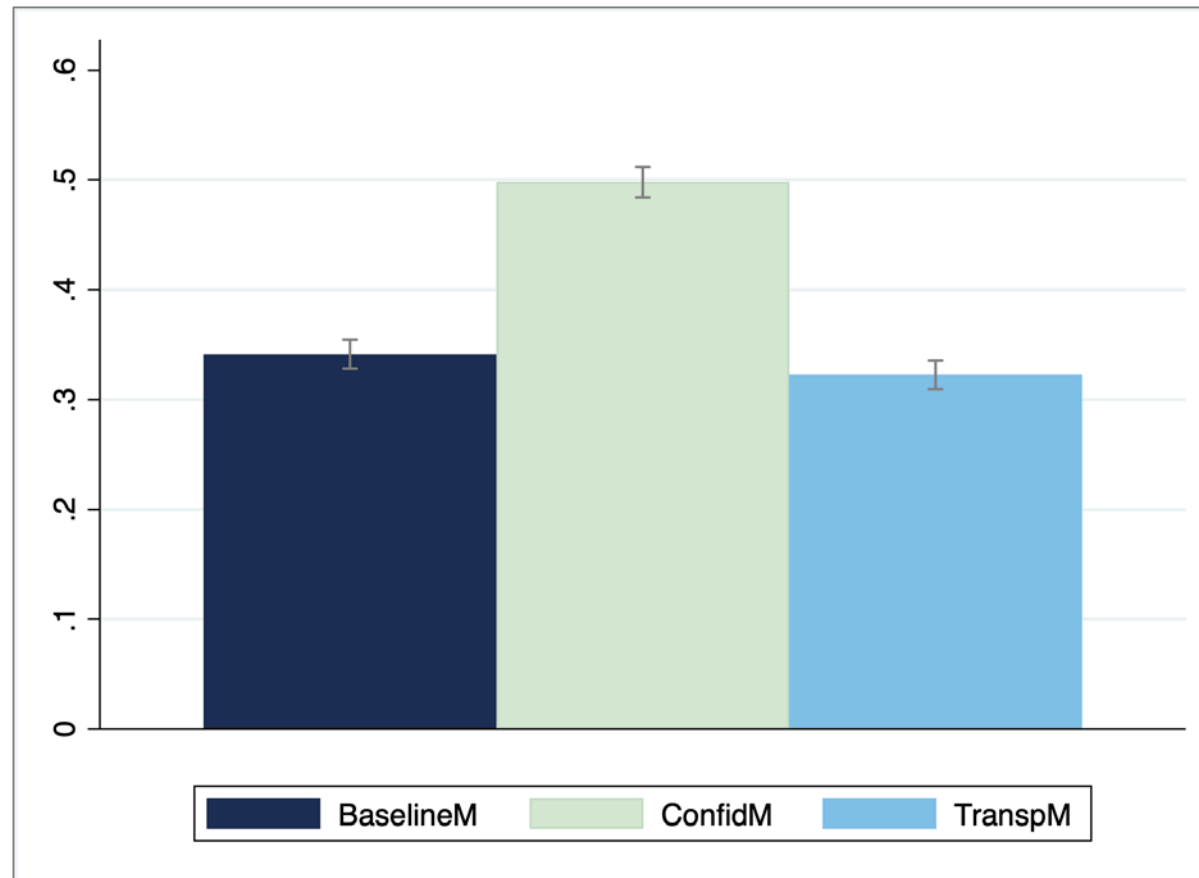
Proportion of workers who chose the algorithm



Main results: Managers



Proportion of managers who delegate to the algorithm



Conclusions: Algorithm aversion

Algorithm aversion constrains market design, but reliance on algorithms can be improved:

- Algorithms **without gender profiling** are preferred, especially by male workers
- **Performance feedback** to managers increases delegation to the algorithm

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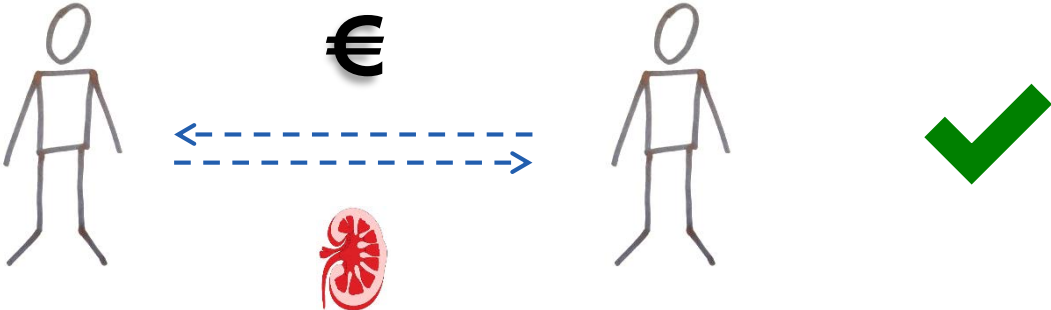
Study 2
Repugnant transactions:
The role of agency and severe
consequences

Hande Erkut (WZB Berlin)

Dorothea Kübler (WZB & Technische Universität Berlin)

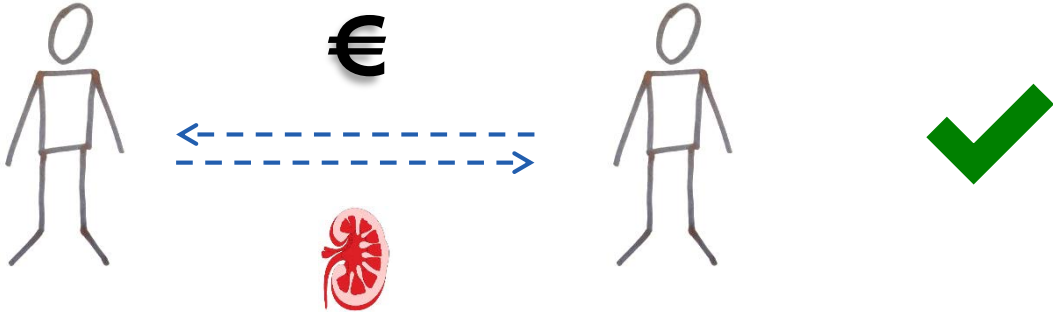
Repugnant transaction

Both parties agree on the exchange

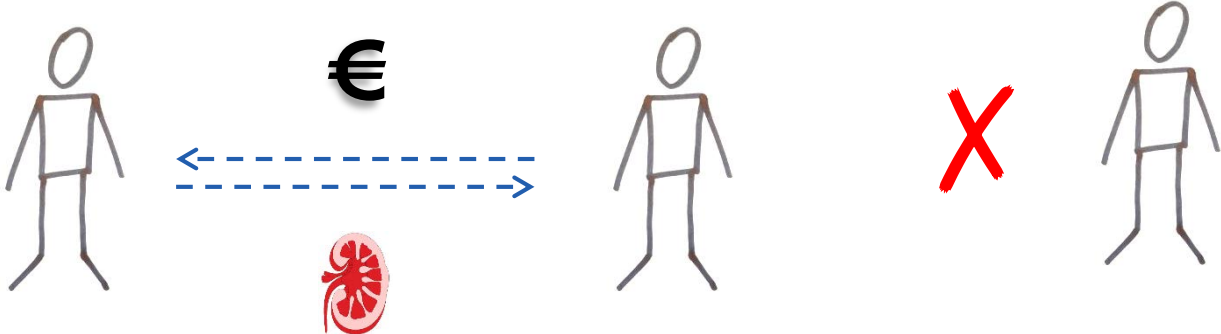


Repugnant transaction

Both parties agree on the exchange,



but a third party finds it inappropriate.



(Ob)noxious / toxic / repugnant transactions

- Body parts (organs from living donors, blood and tissue)
- Reproduction and sex (surrogacy, prostitution)
- Work (mercenaries)
- Politics (public office, voting rights)
- Religion (indulgence trade)
- Nature (emission permits, carbon offsets, trading nuclear waste)

(Walzer 1983; Kanbur 2004; Roth 2007; Leuker/Samartzidis/Hertwig 2021; Jakob/Kübler/Steckel/van Veldhuizen 2019)

What makes a transaction repugnant?

- Severe consequences
 - Loss of human dignity, body parts; erosion of democracy
- Lack of agency
 - Coercion, poverty, lack of information

(Kanbur 2004, Roth 2007, Satz 2008/2012)

Lab experiment



1. Are participants more likely to prohibit a transaction with **severe consequences** than with **harmless consequences**?
2. Are participants more likely to prohibit a transaction where one of the parties has **limited agency** compared to **full agency**?
3. How do these properties interact?

Severe consequence:

Listening for 10 minutes to a painful tone (85 dB and 2083 Hz)

Harmless consequence:

Waiting for 10 minutes

Lab experiment

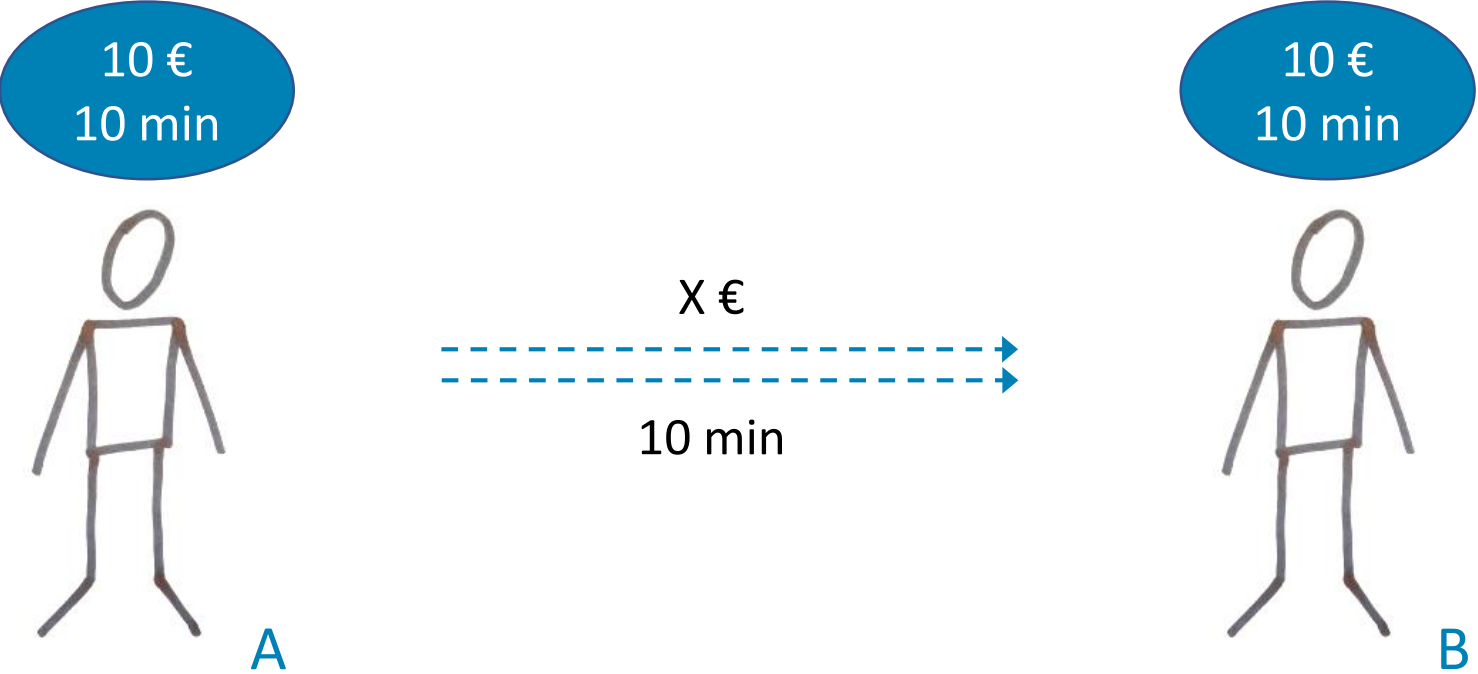


- Exchange of 10 minutes of painful tone [waiting time] against money
- *Before* any offer can be made, spectators decide whether transaction may take place or not
- All participants listen to the tone for one minute before the experiment starts.

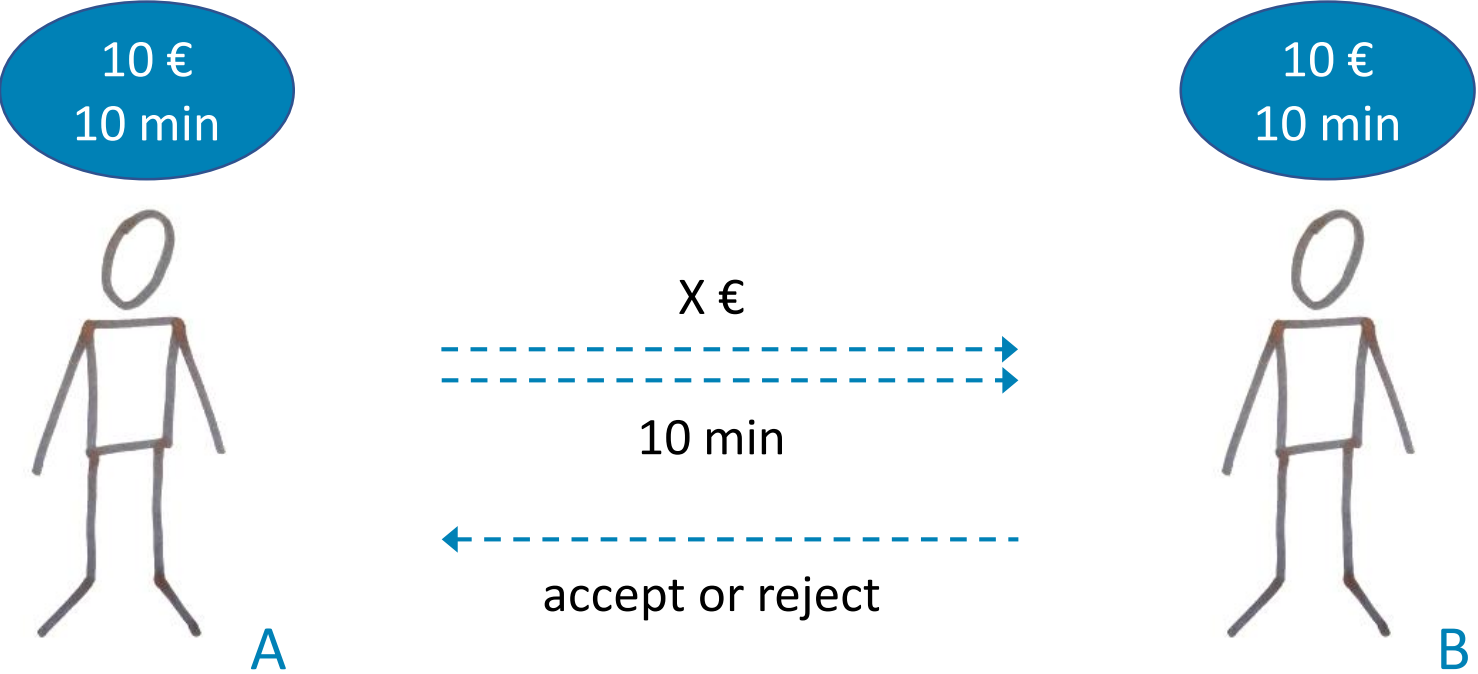
Lab experiment



Lab experiment



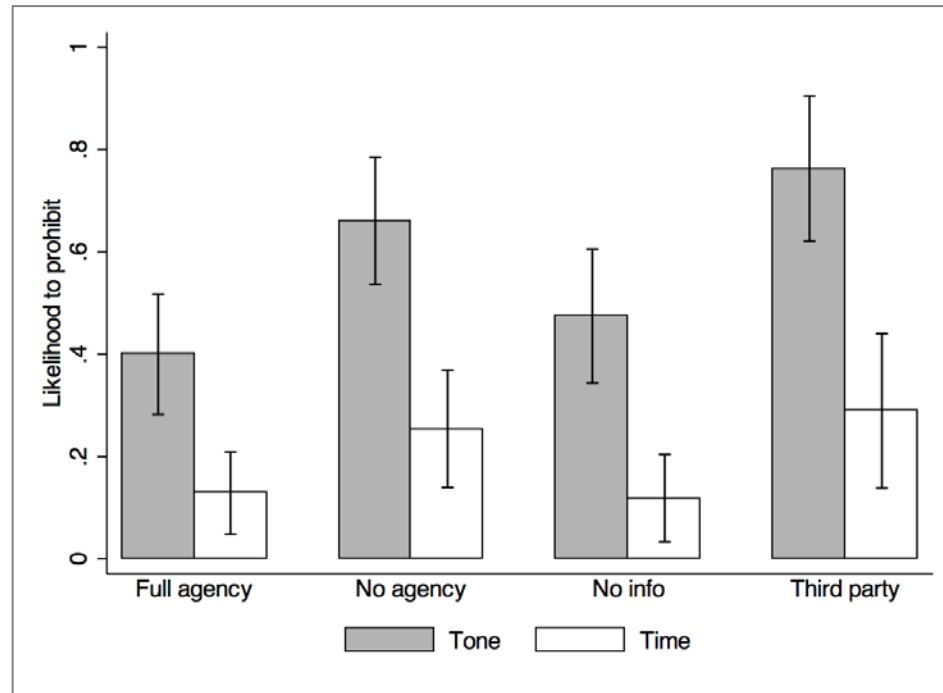
Lab experiment



Limited Agency

Full agency		
B can accept or reject offer.		
No agency	No information	Third party
B cannot reject A's offer.	B does not listen to tone for 1 min.	C decides whether to accept A's offer. If C accepts offer, B gets 10 min, and X € is divided between B and C.

Results: Prohibition of transaction



Severity of outcome and lack of agency are additive regarding repugnance.

Conclusions: Repugnance

- Some goods affect who we are and what society we live in, and some goods save lives
- Limiting market transactions for those goods because of repugnance can be hard on those who want to engage in them
- How can we organize the allocation of such goods in a manner that makes the transactions acceptable?
 - Ensuring agency, e.g., by consent procedures, poverty reduction, public health system, organ exchange
 - Mitigating the consequences, e.g., by health care protection of organ donors, surrogate mothers, prostitutes

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Study 3

Preference discovery in university admissions: The case for dynamic multi-offer mechanisms

Julien Grenet (Paris School of Economics)

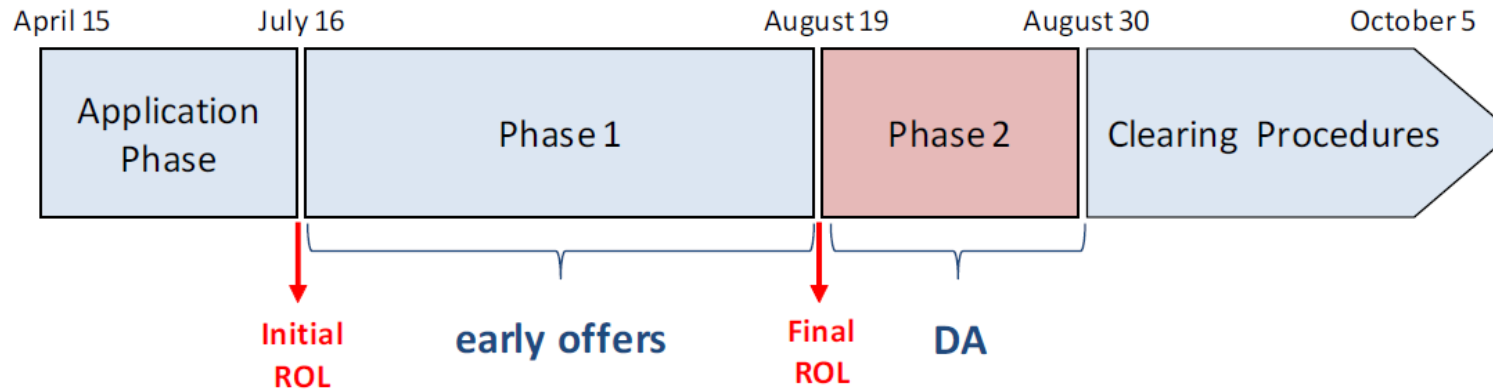
YingHua He (Rice University)

Dorothea Kübler (WZB & Technische Universität Berlin)

Forming preferences in matching markets

- Students and parents spend considerable time and effort collecting information and forming preferences about schools
- However, matching literature typically assumes costless knowledge of preferences
- Study endogeneity of preferences with data from the university admissions process in Germany and what this means for market design

German clearinghouse for university admissions (DoSV)

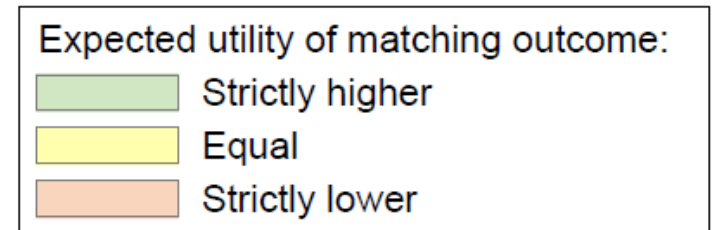
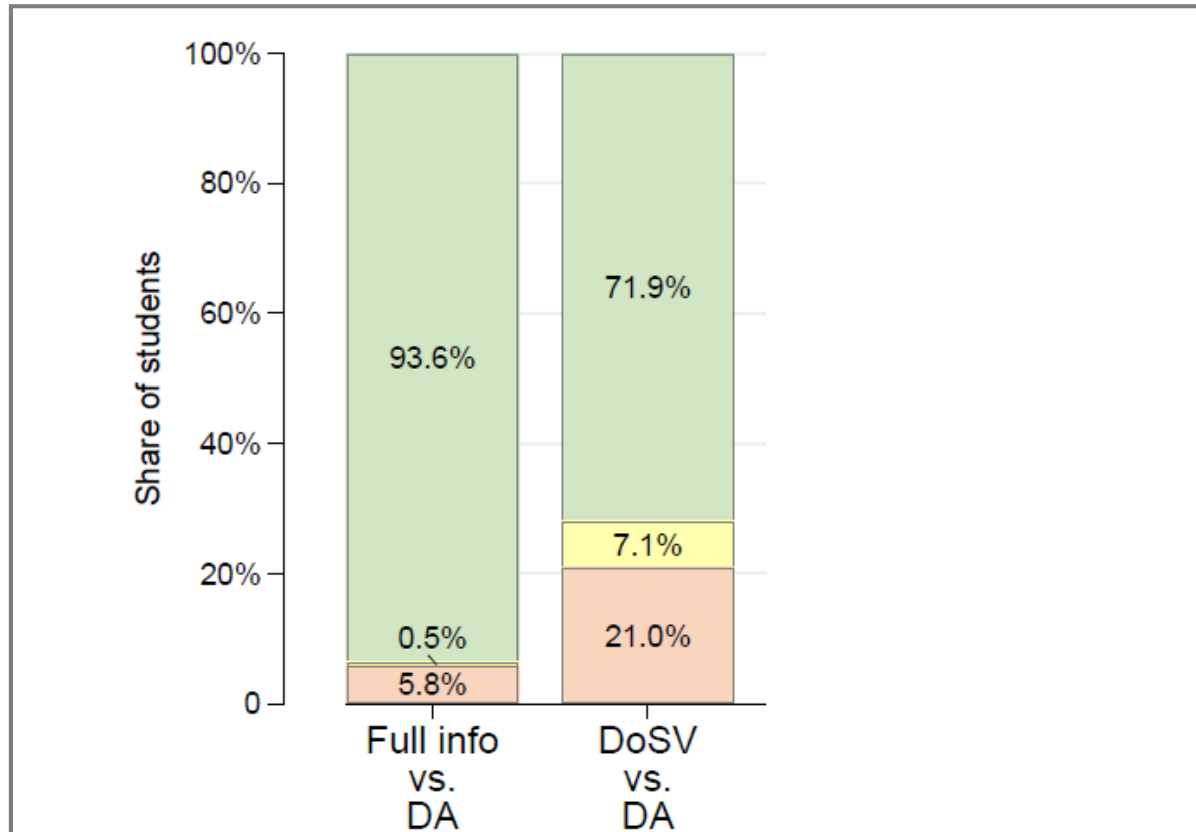


- Application phase
 - Students apply online to up to 12 university programs: initial ROL
 - Programs submit rankings of applicants to the clearinghouse
- Phase 1: Students & programs interact as if in a decentralized market
- Phase 2: Automated Deferred Acceptance procedure based on final ROL which generates at most one offer per applicant

Quasi-experimental evidence against the assumption of known-and-fixed preferences

- **Early offers** are more likely to be **accepted** than later offers
 - Not exploding, not from more selective or more desirable programs, not to get a head-start in housing search
- Consistent with a model where **students learn about university quality** at a cost
 - Corroborated by survey evidence
- What does this mean for the optimal matching mechanism?

Results from simulations with clearinghouse data – based on model with search costs



Conclusions: Preference formation in DoSV procedure

- We document early-offer effect, pointing to malleability of preferences
- Plausible channel: Costly learning about preferences
- German mechanism (DoSV) is a dynamic multiple-offer mechanism that integrates decentralization with centralization
 - Similar: University admissions in France (Parcoursup)
 - Facilitated by IT/internet
- Benefits of integrating decentralization and centralization
 - Centralization: Well-known benefits of thick markets and no congestion
 - Decentralization: Multiple offers & ranking universities after offers

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Study 4

How to avoid black markets for appointments with online booking systems

Rustamdjan Hakimov (University of Lausanne)

C.-Philipp Heller (NERA)

Dorothea Kübler (WZB & Technische Universität Berlin)

Morimitsu Kurino (Keio University)

Black markets for appointments at public offices

- Public offices use online booking systems that work according to the principle of first-come first-served
- These systems are vulnerable to black markets



Visavergabe in Teheran

Ein Termin in der deutschen Botschaft? Das kostet!

Ein Iraner, der Deutschland besuchen will, braucht derzeit viel Geduld - oder Bares: Visa-Termine in der deutschen Botschaft in Teheran werden offenbar auf dem Schwarzmarkt gehandelt. Das Auswärtige Amt sieht das Problem woanders.

Von **Peter Maxwill**

06.07.2015, 10:46 Uhr



‘Bots’ used to block immigrants in Ireland from making visa appointments

Block-booked immigration-service slots then sold via Facebook and phone apps for up to €25

Fri, Sep 7, 2018, 00:53 Updated: Fri, Sep 7, 2018, 10:01

[Sorcha Pollak](#)






People waiting for the Garda National Immigration Bureau to open on Burgh Quay, Dublin in 2014. Photograph: Cyril Byrne / THE IRISH TIMES

Le Monde

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SOCIÉTÉ · IMMIGRATION ET DIVERSITÉ

Partage    

Titres de séjour : le prospère business de la revente de rendez-vous en préfecture

De nombreux étrangers ne parviennent pas à décrocher rapidement un créneau horaire auprès de l'administration. Un marché parallèle s'est mis en place.

Par Julia Pascual et Corentin Nicolas · Publié le 01 juin 2019 à 06h09 - Mis à jour le 01 juin 2019 à 12h01

 Lecture 5 min.

 Article réservé aux abonnés



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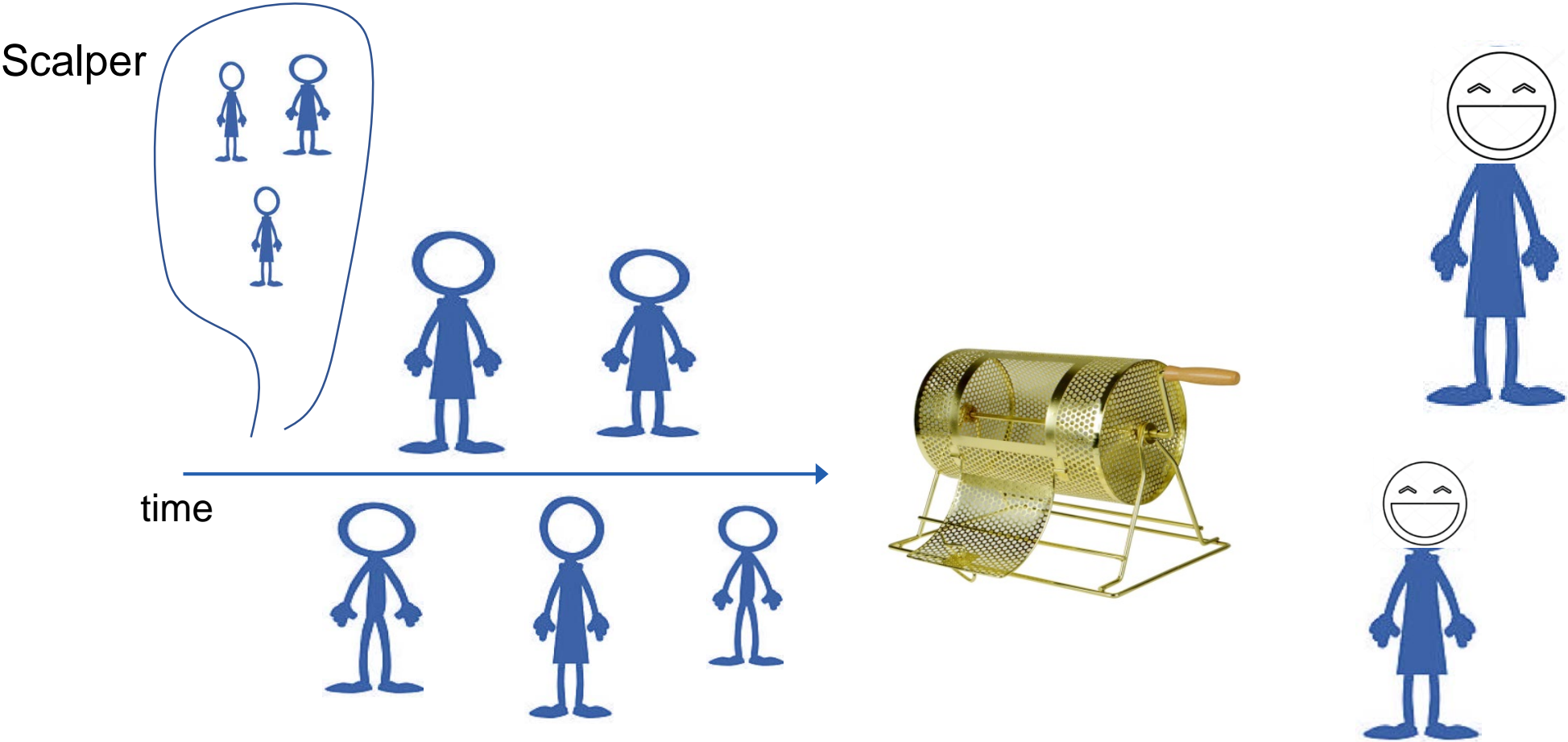
Solution

- Remove advantage of scalpers based on their speed
- Instead of assigning slots immediately, assign them in batches

How does it work?

- Morning: Offer new time slots
- During the day: Seekers enter their names
- Evening: Allocate slots; use random device if more seekers than slots

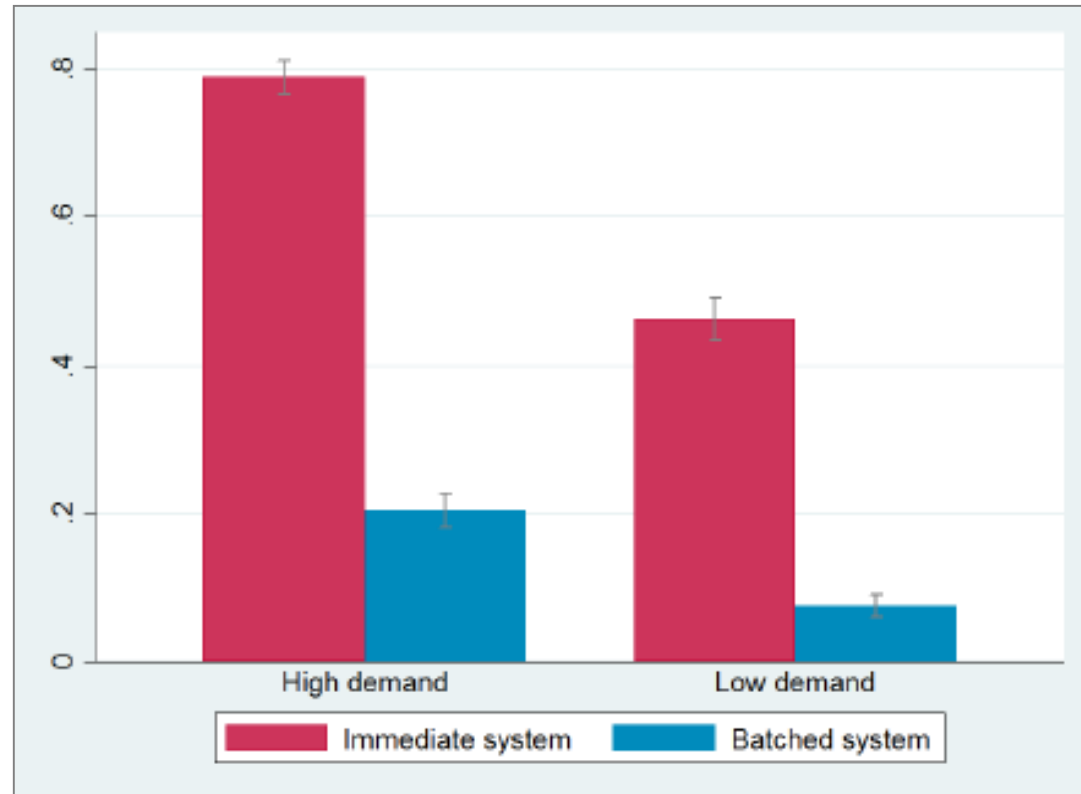
Proposed allocation procedure



Does the batch system work?

- Theoretical prediction: Scalping is profitable only in current (“immediate”) procedure with high demand for slots
- Experiment:
 - Groups of five seekers and one scalper
 - Scalper decides whether to be active or not; seekers decide whether to buy slot from scalper or apply themselves

Market entry of scalpers in old and new allocation system



Scalping can be avoided with appropriate market design.

Conclusions: How to avoid black markets

- First-come first-served systems are vulnerable to scalping
- Proposed batch system also deals with complications (such as scalper submitting applications with fake IDs)
- Similar to re-sale of tickets for concerts and sporting events, limited-edition sneakers etc., but appointments are for free
- Some tourist sites use similar procedures as batch system but it has not been implemented for public offices as far as we know

Final concluding remarks

- Experiments are useful to understand which allocation mechanisms
 - are acceptable (avoid algorithm aversion and repugnance)
 - work well (help students form preferences; avoid black markets)
- Every allocation problem is different, so lots of interesting work ahead!

Thank you!



Hande Erkut



Morimitsu Kurino



Julien Grenet



YingHua He



Rustamdjan Hakimov

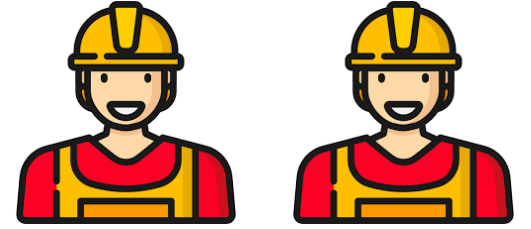


Marie-Pierre Dargnies



C.-Philipp Heller

What determines workers' choice of algorithm?



- The better the workers think they performed, the more likely they are to choose the algorithm
- Workers who believe the algorithm discriminates against their own gender are less likely to choose it
- Male workers are primarily responsible for the increase in algorithmic hiring in NoGenderW
- No difference between choices of male and female workers in TranspW

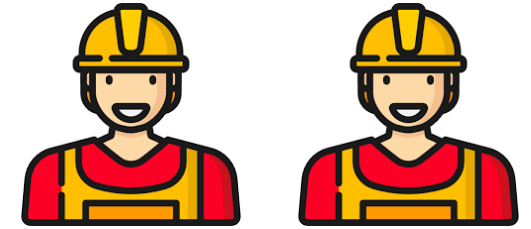
Overconfidence



Managerial overconfidence: difference between belief in how many hires were correct and the actual number of correct hires.

- In BaselineM and TranspM, overconfidence is negatively correlated with delegation
- Higher overconfidence is associated with a significantly stronger treatment effect of ConfidM

Performance and gender



- In task 1 (Raven matrices), men perform better than women
- In task 2 (counting zeros) and in job task 3, no significant gender difference
- For the same task-1 and task-2 performance, women perform better than men
- Correct hiring decisions: 66.9% by algorithm and 55.9% by managers ($p < 0.01$)



More results: Beliefs about payment offered by A

- Full agency:
Likelihood to prohibit is negatively correlated with the expected payment offered by A
- Limited agency:
No significant relationship

Interpretation: If agency is limited or weak, paying a lot does not make the transaction more acceptable

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Study 4

Costly information acquisition in centralized matching markets

Rustamdjan Hakimov (University of Lausanne)

Dorothea Kübler (WZB & Technische Universität Berlin)

Siqi Pan (University of Melbourne)

Matching mechanisms with search: Experimental evidence

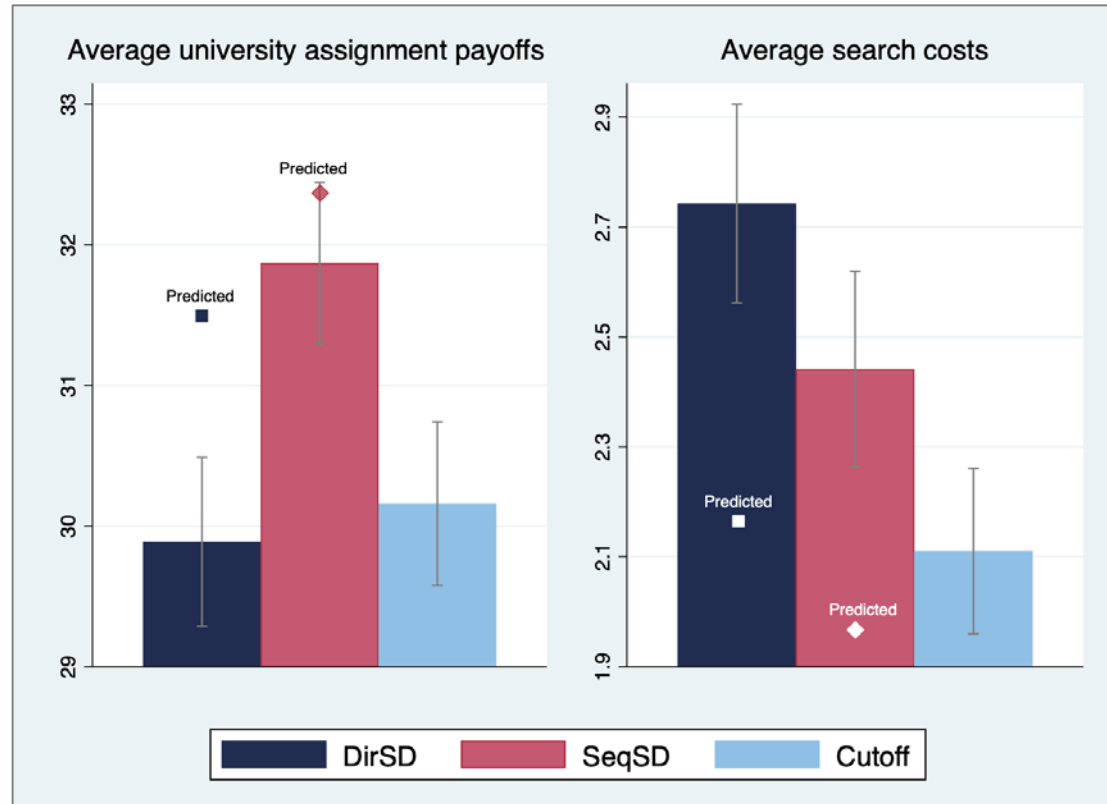
- Experimental setup where students have to learn their ranking of universities at a cost
- Key: To avoid wasteful information acquisition, only search among schools within reach (budget set)
- Budget set depends on
 - (1) a student's priority at universities
 - (2) choices of other students

Study three mechanisms:

- **DirSD**: Direct Serial Dictatorship
- **SeqSD**: Sequential Serial Dictatorship
- **Cutoff**: DirSD + historical cutoff scores



Findings: optimal mechanism with search



Overall student welfare (average payoff): SeqSD > Cutoff > DirSD

Conclusions: Market design when preferences are unknown

Matching markets are increasingly centralized into single-offer procedures

- Works well with known-and-fixed preferences
- Implication of the two studies: Dynamic mechanisms with multiple offers can be optimal if students engage in costly search