Experimental Studies in Matching Markets

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- Offer a controlled environment whereas in field data:
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  - interactions between participants outside of the clearinghouse are difficult to gauge
  - information subjects' have regarding others' preferences is unclear.
- A complement to other kinds of investigation.

School Choice

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- Seminal paper by Abdulkadiroğlu and Sönmez (2003) in AER
  - describes the problems in many US school districts

    "Boston" mechanism (BOS) is problematic: manipulable, inefficient, unfair.

  - proposes specific school choice mechanisms as a solution

    Gale–Shapley (GS) mechanism: strategy–proof, fair
    Top Trading Cycles (TTC): strategy–proof, Pareto efficient.

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- Chen and Sönmez (2006), in *JET*
- Featherstone and Niederle (2008, 2011), *working papers*
- Pais and Pintér (2008), in *GEB*
- Calsamiglia, Haeringer, and Klijn (2010), in *AER*
- Braun, Dwenger, Kübler, and Westkamp (2011), *working paper*
- Klijn, Pais, and Vorsatz (2012), in *Exp. Ecs*
- Chen and Kesten (2013), *working papers*.

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  - The extent of preference manipulation in BOS
  - The extent to which subjects recognize truth–telling as dominant in GS and TTC
  - The impact on efficiency comparisons across mechanisms.

The Experiment

- One–shot game of incomplete information

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- 3×2 design:

    3 mechanisms: BOS, SOSM, TTC
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  - Within priority classes, students are ordered according to a random draw.

Notation

- $x > y$ denotes that a measure under mechanism x is greater than the corresponding measure under mechanism y at the 5% significance level or less
- $x \geq y$ denotes that a measure under mechanism x is greater than the corresponding measure under mechanism y at the 10% level of significance or less (but not supported at 5% level)
- $x \sim y$ denotes that a measure under mechanism x is not significantly different from the corresponding measure under mechanism y at the 10% significance level

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- District school bias (DSB):
  - in both environments $BOS > GS$ and $BOS > TTC$
  - Under BOS, roughly two thirds of the subjects use DSB.

Results: Efficiency

- Using recombinant estimation, efficiency levels (expected per capita payoffs levels) are such that
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- Simulations were used to confirm the efficiency comparison.

Recombinant Estimation (Mullin and Reiley, 2006)

- Each treatment is a one–shot game and was run twice.
- We can recombine students' strategies to compute mean payoffs if players' groupings were different (2^{36} different recombinations).
- Chen and Sönmez (2006) —henceforth CS06— generates 200 recombinations per subject for each of the 72 subjects.
- But, with a higher number of recombinations, Calsamiglia, Haeringer, and Klijn (2011) find that GS is not superior to TTC in the designed environment ($GS \geq TTC$).

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- This gives additional weight to Abdulkadiroğlu and Sönmez recommendation to replace BOS by either of the two mechanisms.

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- Stringent conditions on priorities are necessary and sufficient for stable Nash equilibrium outcomes under GS and TTC.

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Reconduct the CS06 experiment with a constraint on the length of submitted preferences.

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  - In the constrained setting, $GS \sim TTC \sim BOS$ (in contrast with CS06).
- Manipulation:
  - Safety school bias (SSB), ie, including the district school when ranked 4th or below: appears in the 3 mechanisms (more important under GS and TTC).

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  - In the constrained, uncorrelated environment, $TTC \sim GS \sim BOS$, but $TTC > BOS$
  - In both the designed and uncorrelated environment, BOS and GS are significantly less efficient in the constrained case, whereas for TTC the difference is not significant.

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- The performance of both GS and TTC is not substantially better than the BOS.

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- 5 students, 3 schools (2 schools have capacity 2, the third school has capacity 1).

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  - Under Partial and Full information, *GS* $>$ *BOS*
  - Under Zero and Full information, *TTC* $>$ *GS*.

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  - Zero information results in significantly higher efficiency levels under GS and BOS

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  - Zero information results in significantly higher efficiency levels under GS and BOS
  - Information does not affect efficiency under TTC.

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  - But higher efficiency levels.
- Information is important
  - Truth–telling rates are much higher when information is low
  - Efficiency is higher with low information under all mechanisms but TTC, which appears to be less sensitive to information.

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  - When truth–telling is an equilibrium under BOS
  - When there is a unique non–truth–telling equilibrium under BOS.

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  - all students have the same preferences, two classes of students: top and average, top have priority over average
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- Within–subjects design: subjects played for 15 periods with aligned and for 15 periods with uncorrelated preferences and they see the match after every period.

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- Truth–telling
  - With uncorrelated preferences, $GS \sim BOS$
  - With aligned preferences, $GS > BOS$ (and subjects manipulate in a sub–optimal way under BOS).

Results: Efficiency

- Fraction of students receiving their first choices:
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Results: Efficiency

- Fraction of students receiving their first choices:
  - With uncorrelated preferences: $BOS > GS$ (in fact, BOS stochastically dominates GS)
  - With aligned preferences: top students are better off under GS, average students are better off under BOS.

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- In some environments, BOS may dominate GS.

Preference Intensities

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- Klijn, Pais, and Vorsatz (2012) motivated by Abdulkadiroğlu, Che, and Yasuda (2011), in AER, where BOS may dominate GS from an *ex ante* point of view.
- BOS is manipulable and may be sensible to preference intensities and attitudes toward risk.

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  Each subject plays the school choice game 3 times, with different payoff structures.

Results

Strategies:

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Strategies:

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- GS is more robust to changes in cardinal preferences than BOS
- Subjects who are more risk averse are more likely to play a protective strategy under GS but not under the BOS.

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    2. GS is more robust to changes in payoffs (more predictable), while BOS induces agents to reveal their cardinal preferences more often.

- BOS does not necessarily perform worse than GS in terms of efficiency, while GS is more stable and “stability–robust”.

Parallel Mechanisms

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CCA with 2 Parallel Choices

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- 6–school environment: correlated preferences; larger set of Nash equilibrium outcomes; more equilibria under CCA than BOS.

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- Learning separates the performance of the mechanisms in terms of efficiency.

Other Matching Problems

- Two–sided matching

  Echenique, Wilson, and Yariv (2009), *working paper*
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- House allocation problems

  Chen and Sönmez (2002), in *AER*
  Chen and Sönmez (2004), in *Ecs. Letters*
  Guillén and Kesten (2008), *working paper*.

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Pais, Pintér, and Veszteg, 2011

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Decentralized Matching

- Nalbantian and Schotter (1995) analyzes decentralized matching under incomplete information and includes private negotiations between potential match partners.
- Kagel and Roth (2000) analyzes the transition from decentralized to centralized clearinghouses, when the market features lead to inefficient matching through unraveling.
- Haruvy and Ünver (2007) analyzes a decentralized market where one side of the market can make offers and markets are repeated. It shows that the optimal stable matching for the proposing–side of the market is usually reached, independently of the information subjects hold.
- Niederle and Roth (2009) analyzes an incomplete information setting where firms make offers to workers over several experimental periods and study the effect of offer structure (exploding or open offers) on the information that gets used in the final matching and consequent market efficiency. Later, thick markets may appear by allowing only open offers.

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  - outcomes are in most cases stable
  - the median stable matching tends to emerge (independently of having one side or both sides proposing)
  - cardinal representation of agents' preferences affects the selection of stable matchings.

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  - Efficiency:

    commitment corresponds to the highest efficiency levels, whereas costly offers correspond to the lowest.

House Allocation Problems

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