

Brown Course Registration

Market dynamics, strategy-proofness and considerations for alternatives

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Our Model for the Market

- Students $a_1, ..., a_n$ have preferences over bundles of courses $b_1, ..., b_m$
- Preferences can change over time
- $b_i = \{c_v, c_w, c_x, c_y, c_z\}$
- Students can add/drop classes when $t \in [0, s]$
 - Assumption: No transaction time
- \$p_t(c_j) = probability that \$c_j\$ will be available at time t
 \$p_t(c_j) = 1\$ for uncapped courses
 - $p_t(c_j) \in (0,1)$ for capped courses
- $p_t(b_i) = p_t(c_v)...p_t(c_z)$
- $U(b_i) \ge 0$ (due to drops)
- $EU(b_i) > 0 \quad \forall i \quad (uncertainty)$

Problem:

0

The market is not strategy-proof

Students do not have an incentive to state their true preferences until the end of the add/drop period (aka t=s)



Proof

- When t = s
 - $\,\,\circ\,\,$ Students will choose bundle $b_i\,\,\imath$ mong all available bundles such that

 $\max U(b_i)$

• When $t \in [0, s)$

• Students want to maximize their chance to obtain a high utility bundle, so they pick a bundle b_i such that $\max[(1 - p_s(c_v))...(1 - p_s(c_z))EU_t(b_i)]$

Assumption: Risk neutrality

- \circ If $p_s(c_j) = 1$, then the equation becomes 0
- Thus, the student will choose a bundle formed only by capped courses.

Why is this a problem?

- Students do not take certain capped classes because they were initially overbooked
- Students cannot accurately estimate their chances to get into a capped class
- University uses preregistration to assign classrooms and TAs to classes based on size – distorted by strategic playing
- Professors cannot estimate the future size of their class, which can interfere with their planning



Data Analysis

- We want to prove 2 things:
 - Students use this strategy of registering for more capped courses than they plan to take
 - 2. As students have more experience with system, they use this strategy more

	Proportion of registrations that are for capped courses	
	End of Pre-Reg.	End of Reg.
2007		
2008		
2009		
2010		
2011		

- If a greater proportion of course registrations are for capped courses in pre-reg. than final registration, this supports the conclusion that students use this strategy
- If this gap widens over time, we can infer that students are learning to game Banner as they gain experience with the system



Experimental Game

- Students participate in a game with Aassets and B-assets, representing capped and uncapped courses
- A- and B-assets each have two possible values. Participant is shown a set of two possible values for each asset:
 - AI = 3 or 4
 - A2 = 3 or 5
 - A3 = 0 or 9
 - BI = 3 or 4
 - etc

Experimental Game, continued

 Participant is shown 2 possible values for each asset, and chooses a portfolio of 3

• True values of each asset are revealed

• Participant can drop any assets

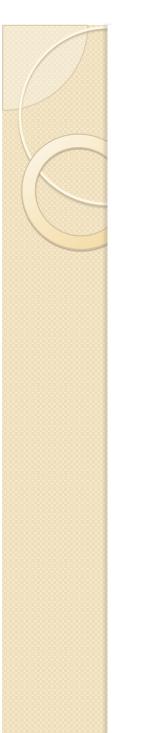
Period I

Period 2

Period 3 • Participant can add any B-assets to their portfolio

The participant receives a cash payout at the end according to the value of the assets in his or her portfolio

Participants will learn over time to always choose A-assets in Period 1, as B-assets can always be added in Period 3



Literature

- Budish and Cantillon, <u>The Multi-unit Assingment</u> <u>Problem: Theory and Evidence from Course</u> <u>Registration at Harvard</u>, *American Economic Review* (forthcoming)
 - (http://faculty.chicagobooth.edu/eric.budish/research/budishcantillon-course-alloc-harvard-May2011.pdf)
- Featherstone, <u>Rank Efficiency: Investigating a</u> <u>Widespread Ordinal Welfare Criterion</u>
 - (http://www.stanford.edu/~cfeather/Featherstone-JobMarketPaper10.pdf)

Literature – Featherstone, 2011

- "A deterministic assignment is ex post efficient if and only if it can be generated by serial dictatorship with indifferences relative to some ordering π"
- Ex post (or Pareto) efficiency if and only if the mechanism can be represented as a lottery over deterministic agents

More on Pareto Efficiency

- A process in which agents can change their registrations after everyone has registered cannot fit this definition of serial dictatorship
- By allowing students to change registrations, Brown does not allow the mechanism to be Pareto efficient
- Brown chooses to give up Pareto efficiency in order to give more weight to students' changing preferences

Literature – Budish and Cantillon, 2011

- Course allocation at Harvard Business
 School
- Comparing manipulable mechanisms to random serial dictatorship
 - Fairness-Efficiency tradeoff? NO
 - Some manipulable mechanisms are more exante efficient than random serial dictatorship, both in terms of individual welfare (if risk neutral or averse) and social welfare

Considerations for Alternatives

- Dean Lassonde and Registrar Fitzgerald: Departments have ultimate say on how students should be selected for courses
- Any alternative must not threaten department choice
- For example: this poses a problem with instituting a waitlist for courses
- However, it wouldn't be a problem with creating an optional waitlist system that worked under a mechanism preferred by the department
- Would not be able to implement one overarching mechanism for all courses because that would challenge "department supremacy"
- Would have to build "optional add-ons" to current mechanisms.



Operational Constraints

 Must be easily operated by professors, department administrators, and students

Business Constraints

- A company like Banner has a small market for advanced course registration mechanisms (only Brown and institutions with similar curricular philosophies)
- Costs of developing them are very high



Add-Ons

- Fitzgerald: Banner has built-on features on top of Banner's code (eg – Brown Course Scheduler). If Brown changes their code, Banner cannot be upgraded
- This leaves Brown somewhat limited in terms of what kind of "optional add-ons" the could make to Banner (or any of its competitors)
- Add-ons should not interfere with Banner's code



Conclusion

- Market for course registration is not strategy-proof
- This theoretical prediction can be tested:
 - Real data analysis
 - Experimental game
- There are several constraints on the alternatives to the current system
- Questions? Comments?