Introduction

Thilo Klein

ZEW Mannheim

"*Only recently have we economists started to understand enough about how markets work so that we can help in that process.*"

Alvin E. Roth

2012 Nobel Prize laureate (with Lloyd Shapley)
"*for the theory of stable allocations and the practice of market design.*"

Market Design

Market design is the area of economics where economists analyze and improve the way markets work.

Critical ingredients to a succesful design:

- Understanding existing institutions
- Good theory
- Good computational modeling
- Well-designed experiments

What is a market?

In economics, whenever there is:

- a demand for *something*
- a supply for *that* something

There is a market for *that* something.

The traditional approach consists of finding an equilibrium price, i.e., a price p such that:

$$\sharp \text{ units buyers are willing to buy at } p \text{ or more}$$
$$=$$
$$\sharp \text{ units sellers are willing to sell for } p \text{ or less}$$

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Questions

- How do we get the equilibrium price?
- Is the "price recipe" the same for all markets?
- What if the price is not the only parameter driving individuals' decisions?

  What if there's no price? (no monetary transactions between sellers and buyers)
- What if the price is "shared"? (e.g., roommates sharing a rent)

The exact details about how to organize a market do matter: they will affect agents' behavior and ultimately affect:

- Who gets what
- At what price (if there's a price...).

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The Easy case

A market for a very common good (e.g., milk):

- Milk is the same everywhere
- Large number of buyers and sellers
- Quantities for demand/supply can be adjusted
- sellers (i.e., stores) adjust their prices up/down, depending on the sales. Consumers react to prices. After some time, prices stabilize and we get an "equilibrium" price.
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More difficult

There's a Monet painting. Seller wants at least $\$1,000,000$.

- Price discovery: How do we get to know the price buyers are willing to accept?
- Each buyer has a maximum price at which he/she is willing to buy the painting:
  - Alice has the highest such maximum price: $\$5,000,000$.
  - Bob has the 2nd highest maximum price: $\$2,000,000$.
- There's only one such painting, so we need to find the price such that there's at most one buyer.

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More challenging

- College admission: large demand (students) and large supply (colleges).
- price = tuition
- Looks like the market for milk. So, why don't we have a "*market for college admission*"?

  We're obviously not in equilibrium: top schools accept less than 5% of the applicants.

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- What matters here: Buyers/sellers do not only care about the good they are buying/selling (education), but also with whom they make transaction:

  Colleges and students have preferences over each other. Price (tuition) is not the only variable of decision.

- Conclusion: price may affect people's decisions, but may not be sufficient to determine the "equilibrium" (or the final allocation).

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Even worse

What if there's no monetary transaction at all?

- In almost all countries, selling/buying human organs for transplants is illegal
- Yet, there is a market: a demand (patients) and a supply (live/cadaveric donors).
- Is there a way to organize such markets?

Prices may have adverse effects, too.

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- Such compensation may prevent donation ("I don't do that for money").

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Market Design: a first example

- Food banks provide food to the poor.
- Distribution is typically done at the local level (food pantries, soup kitchens, churches, community centers, etc.) .
- Food in a food pantry can originate from nearby and far away (via regional food bank).

Feeding America

- 3rd largest not-for-profit in the US after the Red Cross and United Way Worldwide).
- Sources food donations from
  - Large food manufacturers
  - Large distributors
  - small/local entities

  and allocated it to $\approx$ 210 regional entities.
- 2 ways for distribution:
  - facilitate donations from donor to a particular food bank
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How to allocate food?

Feeding America receives donations (truckloads of some particular products). How to allocate it to regional food banks?

Objetives

- Fairness: allocate to the neediest foodbanks

  $\rightarrow$ Need to calculate the needs of each foodbank.

- Don't waste:
  - Avoid spoiling food.
  - If some food donation is not distributed the donnors may refrain to make future donation.

  $\rightarrow$ Need to incentivize food banks to accept food donations from Feeding America.

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- Feeding America calculates for each food bank
  - The pounds of food that is **should** receive (using comparisons across food banks and population size in service area)
  - The pounds of food that is received.
- Food offered to banks, starting with the bank with the highest ratio

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A food bank would be proposed some food. Then choices between

- Yes.
  - Food bank is liable for transportation costs.
  - The "received pounds" add up to the tally, thus changing the ranking of the food bank in the queue.
- No
  - The "received pounds" add up to the tally, thus changing the ranking of the food bank in the queue (as if the food bank said "yes").

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Incentives (cont'd)

But incentives may be too harsh:

- If the food cannot be stored for long, forcing the food bank to accept may be counterproductive.

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- transportation cost can be prohibitive for long distance,

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Problems

- Some food banks would receive food they didn't need.

  E.g., Idaho food bank receiving potatoes.

- Some food banks would never receive food they need.

  E.g., Alaska food bank never receives offer for produce.

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Problems from a market perspective

Lack of information:

- Food banks typically receive only 20% from Feeding America (and FA knows little about the other 80%).

  So FA is deciding what is best for food banks without really knowing their needs.

- For FA, 1 pound of potato chips = 1 pound milk = 1 pound frozen meat = 1 pount of whatever.

  $\rightarrow$ needs, regional differences, nutritional value, transportation costs not taken into account.

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Fixing the allocation system: Issues

- One key issue is to reveal information, i.e., food banks reveal how much they need each particular item.
- Need to introduce choice. So we need a budget.
- Without a budget, a consumer raises her hand for all items, and thus choice become uninformative:

  We need a tradeoff to elicit choices/preferences. A limited budget forces agents to choose between different options.

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In 2004 Feeding America created a task force to fix the problem.

- 9 directors of regional food banks
- 3 senior staff at Feeding America
- 4 economists from the University of Chicago

For the economists, a solution quickly came out: use a market mechanism. But...

- Markets have a bad reputation, they don't always work well.
- Food banks precisely targets those who are left out by the system.
- One food bank director initially said:

> *"I am a socialist. That's why I run a food bank. I don't believe in markets. I'm not saying I won't listen, but I am against this."*

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For the economists, a solution quickly came out: use a market mechanism. But...

- Markets have a bad reputation, they don't always work well.
- Food banks precisely targets those who are left out by the system.
- One food bank director initially said:

> *"I am a socialist. That's why I run a food bank. I don't believe in markets. I'm not saying I won't listen, but I am against this."*

In 2004 Feeding America created a task force to fix the problem.

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Introducing prices?

- Prices are valuable: solve the local knowledge problem, showing how much people value different things.
- Real money not the right solution: neediest food banks may be the poorest.
- What about fake money? Just give fake money to the food banks.
- How do we ensure that the neediest get the most food?

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The auction

- FA distributed "shares" to food banks, with neediest banks receiving more shares.
- Everyday, food banks log onto a website where food offering are posted.
  On average, 30-40 offerings/day
- Two auctions/day, first-price, sealed bid auction:
  - clearer for participants
  - avoid sniping (by large food banks)
- All shares spent on a given day redistributed at midnight, using the same formula as for the initial allocation.

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Additional features

- **Joint bidding** allowed. Helps small food banks: truck for transportation creates an indivisibility.
- **Delegated bidding**: food banks can delegate bidding to FA (explaining their needs).
- **Credit**: Food banks can access credit, paid off with their future allocations. One credit at a time.

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  - Allow them to "sell" this food on the market.
  - 10% tax imposed on these sales (indicates "food richness", FA want to level the playing field).
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Results

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  - highly demanded (meat, poultry, fish)
  - least demanded (produce, sugary drinks, potato chips).
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Outlook

Topics covered:

1. Introduction
2. The basic matching model
3. The medical match
4. Assignment markets
5. School choice
6. Course allocation
7. Kidney exchange

Handouts:

→ https://klein.uk/teaching/matching/

Textbook:

→ Haeringer, G. (2018). Market Design: Auctions and Matching. The MIT Press.