Matching mechanisms: Two sided markets with priority matching for kindergarten slots allocation

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Contents

Childcare – important?

Two main reasons (officially ECEC – early childhood education and care in EU) is important in contemporary public policy:

- Human capital based argument - early investment for future labour force; no trade-off between efficiency and equity
- New social risk based argument – the need to reconcile work and family life

  Both are based on social investment paradigm which is also the official agenda of EU (Lisbon Treaty)

Social investment paradigm of welfare states

- Not gender-neutral
- Childcare is not the only focus of comparative family policy and social investment strategy, but one of the key elements within it

What other countries do?

Family policy

- Multidimensional (includes different policy areas (labour-market, social insurance, education etc)
- Multi-targeted (increase women's labour, positive effect on birth rates, early investment in children, alleviate inequality, . . .)

Configurational approach

- There are countries which have been successful in many targets – Scandinavia particularly, but in most cases focus is either in childcare (France, the Netherlands) or in parental leave (Eastern-European countries)
- One-dimensional focus may paradoxically worsen the situation, for instance accumulate inequality (Esping-Andersen)

Ideal model of contemporary family-policy (E-A 2009)

Model:

- Moderately generous and reasonably long parental leave (1 year)
- Accessible and qualitative ECEC (starting from 1)
- Flexible labour market opportunities

Case of Estonia?

Local KG market: Tallinn

Usual problems without design

- policy-makers apply ad-hoc solutions
- ex-ante allocations (no agents preferences considered)
- intransparent (unclear how allocations are made)
- open to strategic manipulation (due to rigid criteria)

Regulations in Estonia

Triin is making an overview (work in process)

Decentralised market

- Parents make 3 individual applications
- KG head's accept (based on ????)and reject
- Parents accept/reject

Bad practices (folk empirics)

- give gifts to the head
- promise to do something
- be famous

How to research: What to observe in a mechanism?

Who makes the selection?

- Is it the parent?
- Or is it the kindergarten? Who in kindergarten?

Whom KG prefer? Parents list 3 preferences but have also outside option (private)

Can kindergartens or families do better in the matching?

Who gets in?

- Can you see what is the 'algorithm' for the matching?
- Who gets the slots (those who have born in Sept-Nov)?
- those with siblings in the same KG?
- parents who 'were convincing' in meeting with the head?

Boston mechanism (used in Boston, MA until 2005)

Mechanism [Abdulkadiroğlu and Sönmez, 2003]

1 For each school consider the students who have listed the school as their first choice. Assign these students to the school in the priority order (based on distance and siblings) until no more seats or students

k For each school that has free seats consider students who have listed the school as their kth choice. Assign these students to the school in the priority order until no more seats or students

Schools $S = \{a, b, c\}$ with capacities $S_q = \{2, 1, 1\}$.

School priorities	Student preferences	Allocation
$a : i_4 \succ i_1 \succ i_2 \succ i_3$	$P_{i_1} : a \succ b \succ c$	$\begin{pmatrix} i_1 & i_2 & i_3 & i_4 \\ a & a & b & c \end{pmatrix}$
$b : i_3 \succ i_4 \succ i_1 \succ i_2$	$P_{i_2} : a \succ b \succ c$	
$c : i_3 \succ i_4 \succ i_2 \succ i_1$	$P_{i_3} : a \succ c \succ b$	
	$P_{i_4} : c \succ a \succ b$	Lowest: 3, Total: 6

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Schools $S = \{a, b, c\}$ with capacities $S_q = \{2, 1, 1\}$.

School priorities

$a : i_4 \succ i_1 \succ i_2 \succ i_3$

$b : i_3 \succ i_4 \succ i_1 \succ i_2$

$c : i_3 \succ i_4 \succ i_2 \succ i_1$

Student preferences

$P_{i_1} : a \succ b \succ c$

$P_{i_2} : a \succ b \succ c$

$P_{i_3} : a \succ c \succ b$

$P_{i_4} : c \succ a \succ b$

Allocation

$$\begin{pmatrix} i_1 & i_2 & i_3 & i_4 \\ a & a & b & c \end{pmatrix}$$

Lowest: 3, Total: 6

$c - i_3$ is a **blocking pair** - both prefer each other over their current match

Deferred-Acceptance

Mechanism [Abdulkadiroğlu and Sönmez, 2003], [Roth, 2008]

1. Students propose to their top choice. Schools reject students that are not on their list and students who are over their capacity, based on the priority. Others are tentatively assigned to the school

k. Students previously rejected propose to their next school. Each school considers the new proposals and tentatively accepted proposals that are on their list and are not over their capacity. Others are rejected

Algorithm terminates when there are no more proposals: i.e. all students are assigned to a school or rejected by all schools in his list

School priorities

$a : i_4 \succ i_1 \succ i_2 \succ i_3$

$b : i_3 \succ i_4 \succ i_1 \succ i_2$

$c : i_3 \succ i_4 \succ i_2 \succ i_1$

Student preferences

$P_{i_1} : a \succ b \succ c$

$P_{i_2} : a \succ b \succ c$

$P_{i_3} : a \succ c \succ b$

$P_{i_4} : c \succ a \succ b$

Allocation

$$\begin{pmatrix} i_1 & i_2 & i_3 & i_4 \\ a & b & c & a \end{pmatrix}$$

Lowest: 2, Total: 7

Deferred-Acceptance Properties

Matching from Deferred-Acceptance is stable - no blocking pairs

Strategy-proofness

For the student side only.

Matching Optimality

Two-Sided stable matching is always optimal to the proposing side and worst to the accepting/rejecting side. See [Roth, 2008]

Some market examples

- Matching primary school students to schools in Boston and England [Pathak and Sönmez, 2011]
- Matching MD students to residency position in hospitals and several other labor markets in US [Roth, 2008]
- Matching of high-school students in NY

Top-Trading Cycles

Mechanism [Abdulkadiroğlu and Sönmez, 2003]

1. Each school point to its favourite student and each student to his favourite school. Each student is part of at most one cycle. Every student in a cycle is assigned in a school he points to. Capacity in each school is reduced by one

k. Each remaining student point to a favourite remaining seat in a school, similarly for schools. There is at least one cycled and the seats are assigned, until there are no more cycles

School priorities

$a : i_4 \succ i_1 \succ i_2 \succ i_3$

$b : i_3 \succ i_4 \succ i_1 \succ i_2$

$c : i_3 \succ i_4 \succ i_2 \succ i_1$

Student preferences

$P_{i_1} : a \succ b \succ c$

$P_{i_2} : a \succ b \succ c$

$P_{i_3} : a \succ c \succ b$

$P_{i_4} : c \succ a \succ b$

Allocation

$$\begin{pmatrix} i_1 & i_2 & i_3 & i_4 \\ a & b & a & c \end{pmatrix}$$

Lowest: 2, Total: 5

Good properties [Roth, 2008]

Thickness

For market to have enough participants to be relevant.

Non-Manipulability

To make it safe to reveal their preferences to the market mechanism

Clearing, solving congestion

Find a solution in reasonable time

Policy considerations in KG allocation

Who makes the selection?

kindergartens, local municipalities or families?

What kind of priorities KG should have?

- How to define priorities/preferences for KG?
- This is the question that is outside of design
- Are KG merely objects consumed by parents? (see next quote)

The central difference between the college admissions and school choice is that in college admissions, schools themselves are agents which have preferences over students, whereas in school choice, schools are merely "objects" to be consumed by the students. This distinction is important because the education of students is not and probably should not be organized in a market-like institution. A student should not be rejected by a school because of her personality or ability level [Abdulkadiroğlu and Sönmez, 2003].

'Blind' proposal for KG matching

Central mechanism (How central?)

Allow parents to present full (long) preference lists

Use student optimal deferred-acceptance algorithm

Policy questions

- Priorities: Distance (walk zone), siblings, etc.????
- Local or universal priorities?

Quotas

Use quotas to provide opportunity a chance for all to attend a KG. For example 50% of families are admitted based on a distance from the KG and 25% with siblings priority and 25% selected randomly.

Thank You

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Quota slots in School Choice

Quotas

Reserve some set of seats to a group of students: e.g. living in a walk-zone of the school. Inside each quota the students are considered equivalent

Example from [Dur et al., 2013]

Four schools $A = \{k, l, m, n\}$, with two seats each.
Eight students $I = \{i_1, i_2, i_3, i_4, i_5, i_6, i_7, i_8\}$
Walk-zone students $I_k = \{i_1, i_2\}$, $I_l = \{i_3, i_4\}$, $I_m = \{i_5, i_6\}$, $I_n = \{i_7, i_8\}$
Tie breaking $\pi = i_1 \succ i_8 \succ i_3 \succ i_4 \succ i_5 \succ i_6 \succ i_7 \succ i_2$

p_{i_1}	p_{i_2}	p_{i_3}	p_{i_4}	p_{i_5}	p_{i_6}	p_{i_7}	p_{i_8}
k	k	l	l	m	m	n	k
l	l	k	k	k	k	k	l
m	m	m	m	l	l	l	m
n	n	n	n	n	n	m	n

Solutions for using quota slots

Example from [Dur et al., 2013]

Tie breaking $\pi = i_1 \succ i_8 \succ i_3 \succ i_4 \succ i_5 \succ i_6 \succ i_7 \succ i_2$

All with one slot walk zone precedence

$$\mu = \begin{pmatrix} i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 \\ k_w & n & l & l & m & m & n & k_o \end{pmatrix}$$

School k has two others one walk zone slot precedence

$$\mu = \begin{pmatrix} i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 \\ k_w & k_w & l_w & m_o & m_w & n_o & n_w & l_o \end{pmatrix}$$

School k has one open zone others one walk zone slot precedence

$$\mu = \begin{pmatrix} i_1 & i_2 & i_3 & i_4 & i_5 & i_6 & i_7 & i_8 \\ k_w & k_o & l_w & m_o & m_w & n_o & n_w & l_o \end{pmatrix}$$