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Toy microsimulation of labour mismatch:
a brief model description and demonstration

Vsevolod Iakovlev

Heriot-Watt University

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General framework

Two-sided matching formulation by Zinn et al. (2012) adopted to labour setting. Define

- a set of n **workers** i and a set of m **jobs** j (posted by the firms)
- s_i and r_j (respective elements of S and R) as **sets of attributes**
- a **compatibility measure** representing the quality of a match
  $c_{ij} = C(s_i, r_j)$, where $C : S \times R \to [0, 1]$; options:
  - a distance function *(selected)*
  - empirical likelihood of matching
- a **matching rule**; options:
  - Stable *(selected)*, e.g. *Gale and Shapley's (1962) deferred acceptance procedure*
  - *Stochastic*, e.g. agents' c_{ij} has to be higher than randomly assigned "aspiration level" (i.e. expectations) for the match to occur

Preliminary demonstration (pre-alpha version) I

Monte Carlo simulation

- ▶ Data is generated using **simple DGPs**
- ▶ **Symmetric sets:** $n = m = 100$
- ▶ $1,000$ repetitions
- ▶ **Two attributes:**

    $s_i = \{education, skill\}$, $r_j = \{required\ education, required\ skill\}$

- ▶ **Same** $C(s_i, r_j)$ for both agent sets defined using a **distance function** that values the attributes equally
- ▶ **Decision rule:** an agent accepts the match if

$$U(c_{ij}, selectivity) \equiv c_{ij} - selectivity \geq 0 \qquad (1)$$

    where *selectivity* (aspiration in Zinn et al. (2012)) serves as a minimum compatibility threshold

Preliminary demonstration (pre-alpha version) II

Specifications:

S_0 **Control:** DGPs specified below

$S_{...}$ **Education policy (stylized):**

S_1 Workers have 50% chance to increase their **skill** by $2\sigma_{skill}$

S_2 Workers have 50% chance to increase their **education** by $2\sigma_{education}$

$S_{...}$ **Change in labour demand (stylized):**

S_3 50% chance a firm increases its **skill requirement** by $2\sigma_{skill}$

S_2 50% chance a firm increases its **education requirement** by $2\sigma_{education}$

Workers I

Attributes (inputs in compatibility measure)

- ▶ **Education:** mimics ISCO skill level, 4 categories, $\sim N(2.7, 0.9^2)$
- ▶ **Skill:** mimics PIAAC literacy scores, 500 points scale, $\sim N(272, 46^2)$

Other variables (used for matching procedure)

- ▶ **Selectivity:** $\in [0, 1]$, arbitrary, $\sim N(0.5, 0.1)$

Workers II
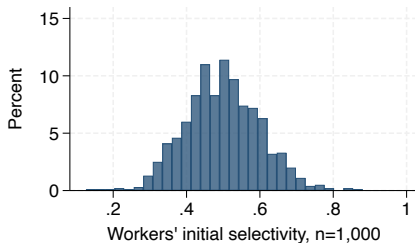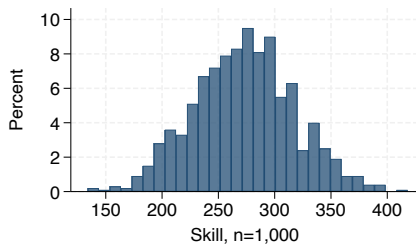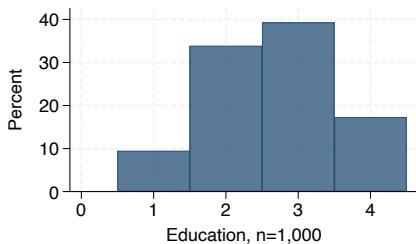
Jobs (Firms) I

Attributes (inputs in compatibility measure)

- ▶ **Required education:** mimics ISCO skill level, 4 categories,
  $\sim N(2.7, 0.9^2)$
- ▶ **Required skill:** mimics PIAAC literacy scores, 500 points scale,
  $\sim N(272, 46^2)$

Other variables (used for matching procedure)

- ▶ **Selectivity:** $\in [0, 1]$, arbitrary, $\sim N(0.5, 0.1)$
- ▶ **Wage:** mimics hourly earnings including bonuses (USD PPP)
  $\sim LogNormal(2.45, 0.71^2)$

Jobs (Firms) II
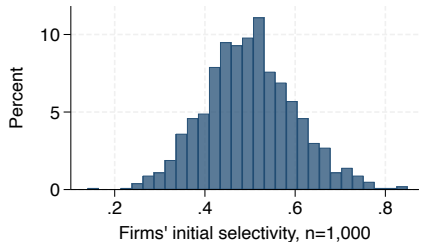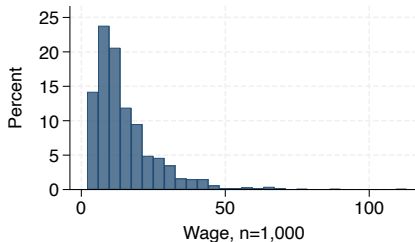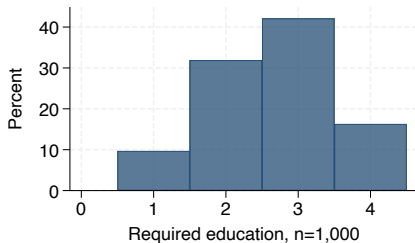
Matching procedure I

In each iteration of the algorithm

1. Generate **network** – a subset of $k \sim N(n/2, (n/10)^2)$ jobs, of which the worker is aware

2. **Worker applies** for the highest-paying (if possible) unmatched job in their network

3. **Compatibility** of the potential match is calculated using a form of an exponential distance function (Perese, 2002)

$$C = \exp\left[-1.4 \times \sqrt{\left(\frac{edu - edu.req}{max_{edu}} \right)^2 + \left(\frac{skill - skill.req}{max_{skill}} \right)^2} \right] \quad (2)$$

Matching procedure II

4. Match occurs if $U(c_{ij}, selectivity_i) \geq 0$ and $U(c_{ij}, selectivity_j) \geq 0$,
   i.e. compatibility is **greater than both** worker's **and** firm's selectivity

5.1 If **match occurs**, then move on to the next worker

5.2 If **match fails** because
   - **firm rejects** worker, then the worker's selectivity is reduced by 0.05
   - **worker rejects** firm, then the firm's selectivity is reduced by 0.05
   - **rejection is mutual**, then both worker's and firm's selectivity levels are reduced by 0.05

and the worker applies for the **next job** in the network

or the algorithm moves on to the **next worker** if there are no unapplied jobs left in the network

The procedure terminates when all workers are matched

Matching procedure III

Special cases

▶ If either worker or job is **already matched**, then they use compatibility of the **current match** (instead of selectivity) to compare with the compatibility of the **potential match**

▶ If worker matches with a matched firm, the worker who is currently "employed" in that firm is "let go" and **no longer matched**

▶ When there are less than 10% of **unmatched jobs left**, they are guaranteed to be in a worker's network and their selectivity is reduced by an additional 0.05

Labour mismatch measures

▶ **Realised Matches (RM):** worker is **well-educated** if their education is within $\pm$ one standard deviation from the mode of education for their occupation group

where **occupation:** 3 categories, function of skill, $\sim Beta(\alpha, \beta)$ with

- $\alpha = 5 - (skill - \mu_{skill})/\sigma_{skill} \times 5$
- $\beta = 5 + (skill - \mu_{skill})/\sigma_{skill} \times 5$

▶ **Indirect Self-Assessment (ISA):** worker is **well-educated** if their education matches firm's requirement

▶ **Pellizzari and Fichen (2017) (PF):** worker is **well-skilled** if their skill is within the 5th and 95th percentiles of the "well-matched" workers' skill distribution for their occupation group

where **"well-matched":** binary, $1(compatibility \geq \mu_{compatibility}^{S_0})$

	μ_{skill}	percent
High-skill occupation	319	33.8
Mid-skill occupation	271	34
Low-skill occupation	224	32.2

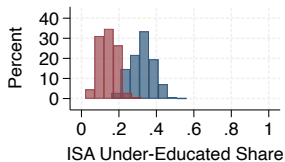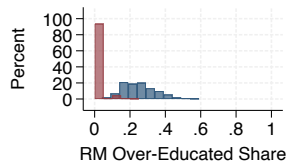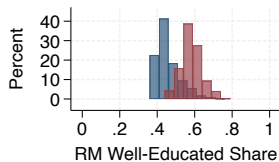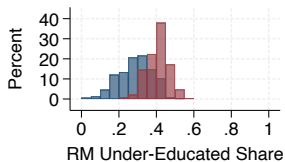|	$\mu_{compat.}$	percent
Well-matched	0.89	34.4
Not well-matched	0.66	65.6

Mismatch measures output: Control (S_0)
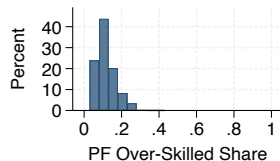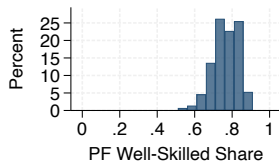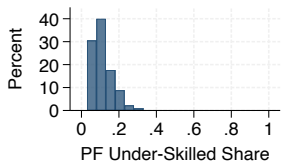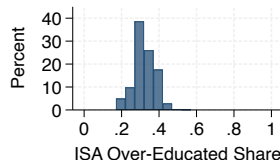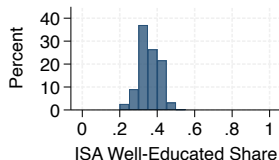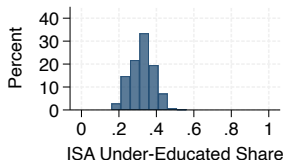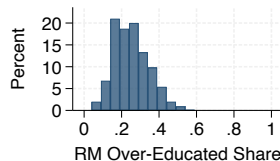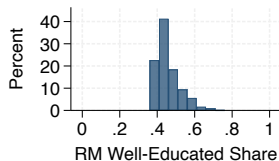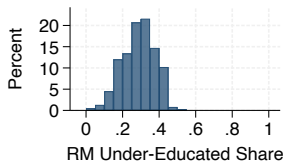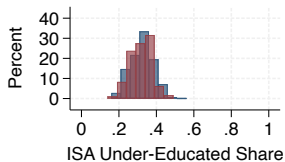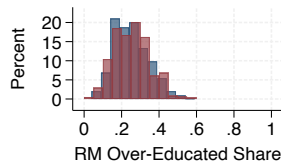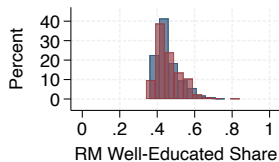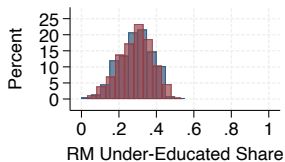
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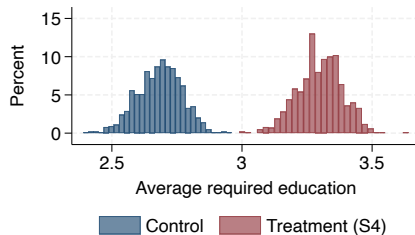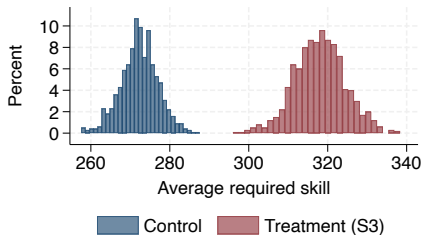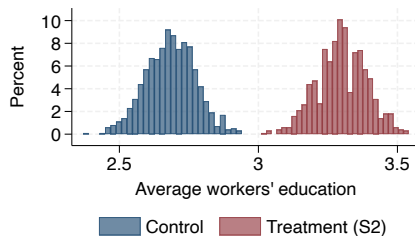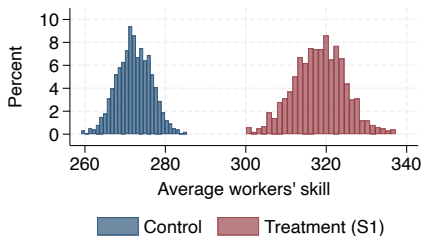
Education policy: skill ↑ (S_1)
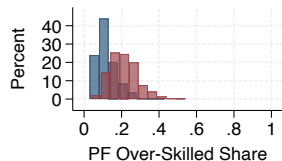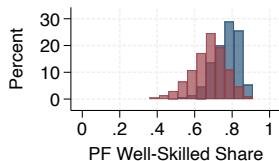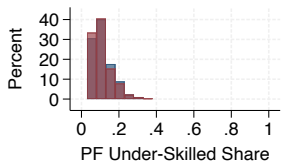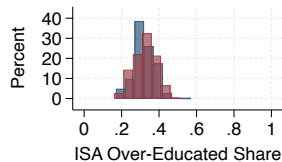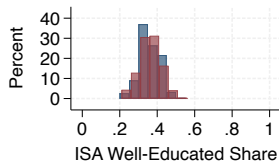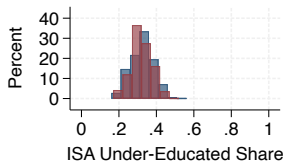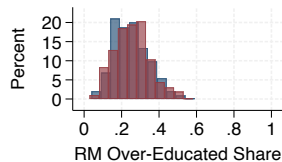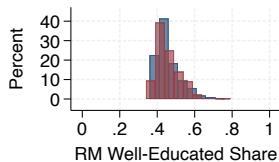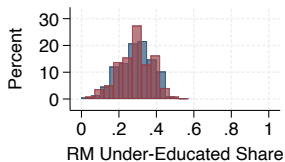
Education policy: education ↑ (S_2)
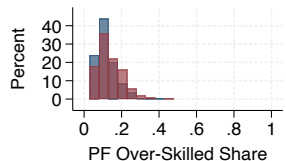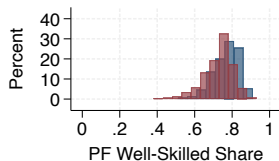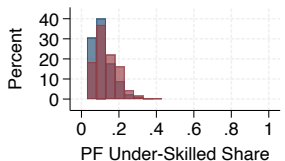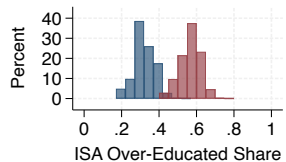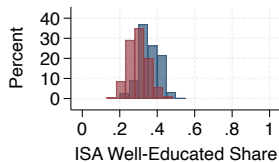
Change in labour demand: required skill ↑ (S_3)
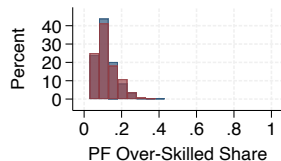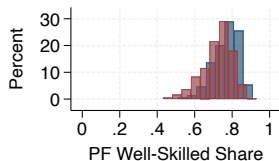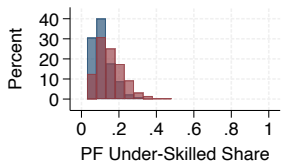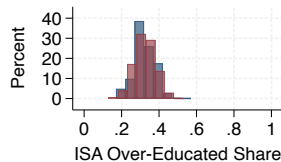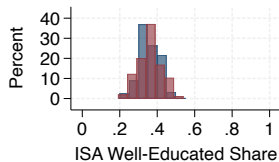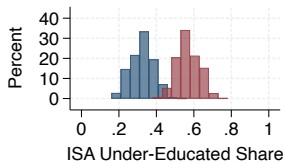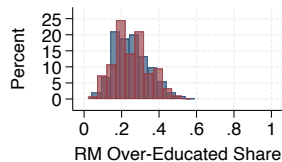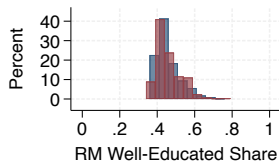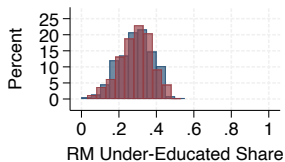
Change in labour demand: required education $\uparrow$ (S_4)
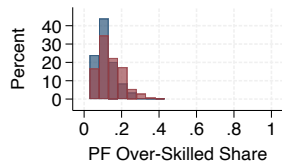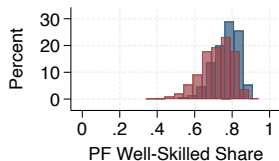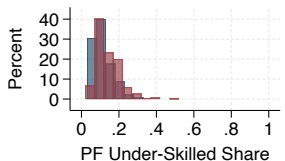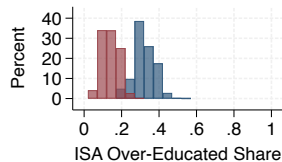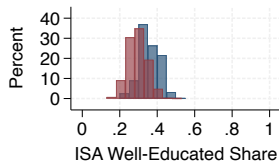
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