

# toysimlm

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

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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  $C : S \times R \rightarrow [0, 1]$ ; 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:**  
 $s_i = \{\text{education}, \text{skill}\}$ ,  $r_j = \{\text{required education}, \text{required skill}\}$
- ▶ **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

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

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

$S_{\dots}$  **Education policy (stylized):**

$S_1$  Workers have a 25% chance to increase their **skill** by  $2\sigma_{skill}$

$S_2$  Workers have a 25% chance to increase their **education** by  $2\sigma_{education}$

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

$S_3$  25% chance a firm increases its **skill requirement** by  $2\sigma_{skill}$

$S_2$  25% chance a firm increases its **education requirement** by  $2\sigma_{education}$

# Workers I

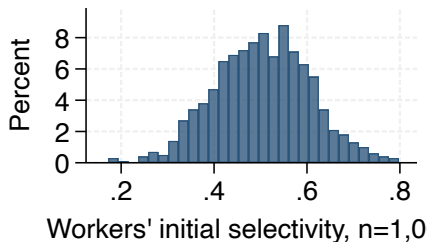
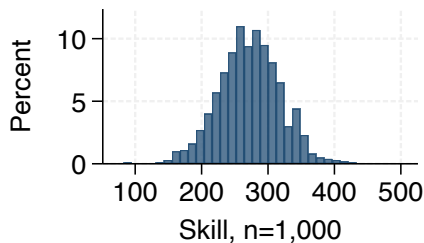
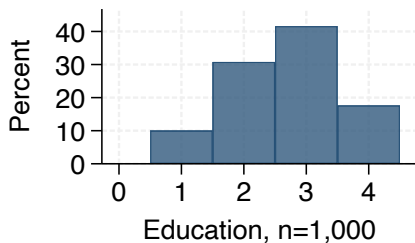
*Attributes (inputs in compatibility measure)*

- ▶ **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

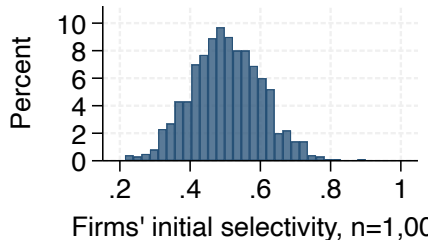
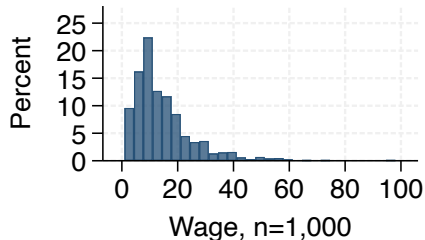
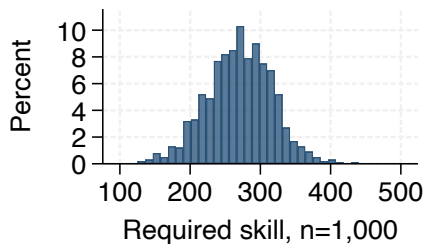
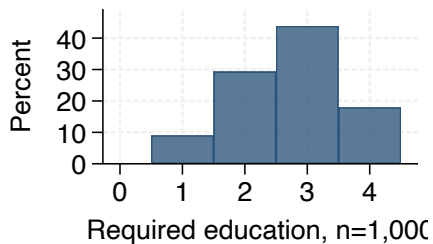
*Attributes (inputs in compatibility measure)*

- ▶ **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)  
 $\sim \text{LogNormal}(2.45, 0.71^2)$

## Jobs (Firms) II





# Matching procedure I

## *In each iteration of the algorithm*

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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

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*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,  $\sim \text{Beta}(\alpha, \beta)$  with

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

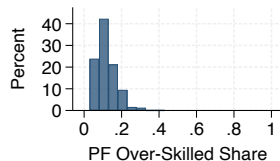
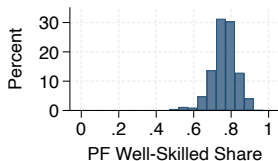
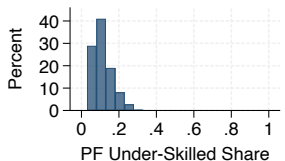
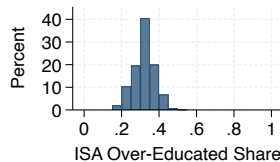
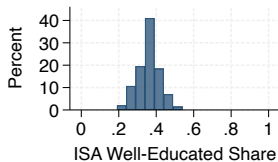
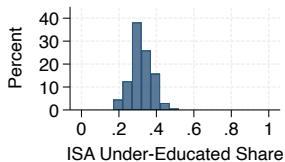
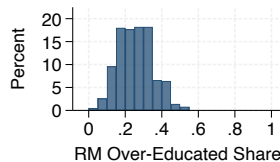
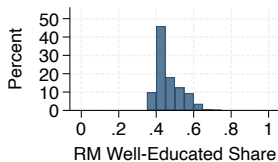
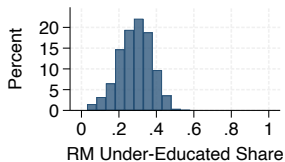
- ▶ **Indirect Self-Assessment (ISA):** worker is **well-educated** if their education matches firm's requirement
- ▶ **Pellizzari and Fichen (2017) (PF):** worker is **well-skilled** if their skill is within the 5th and 95th percentiles of the “well-matched” workers' skill distribution for their occupation group

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

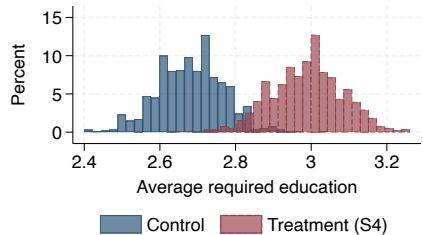
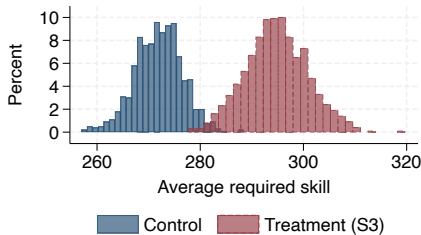
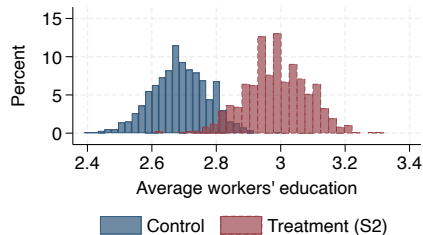
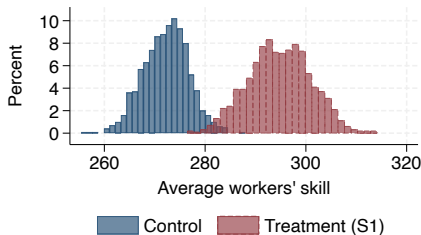
	$\mu_{\text{skill}}$	percent
High-skill occupation	319	33.8
Mid-skill occupation	271	34
Low-skill occupation	224	32.2

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

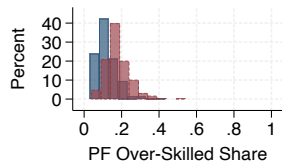
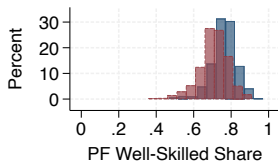
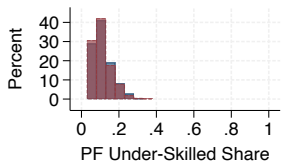
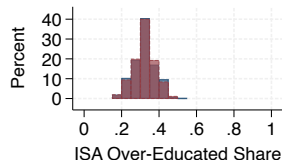
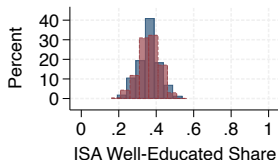
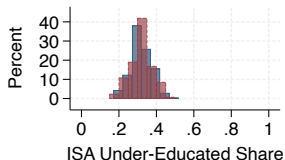
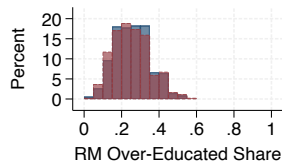
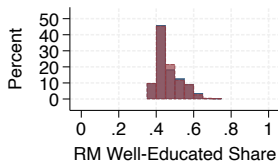
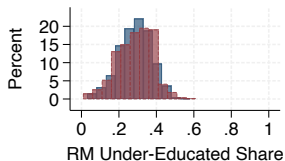
# Mismatch measures output: Control ( $S_0$ )



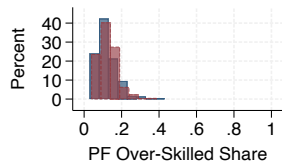
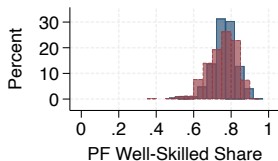
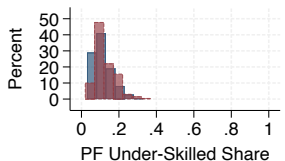
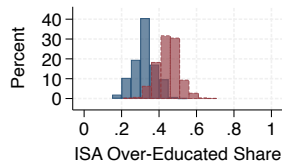
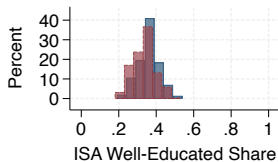
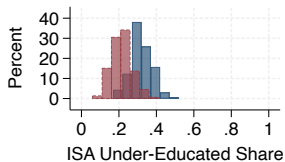
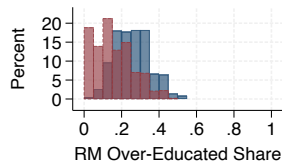
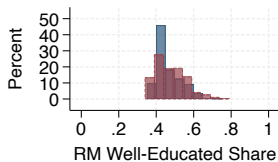
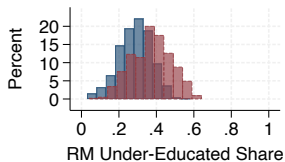
# Treatments



# Education policy: skill $\uparrow$ ( $S_1$ )

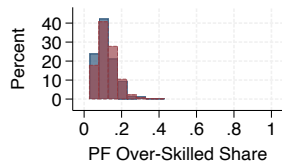
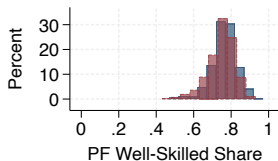
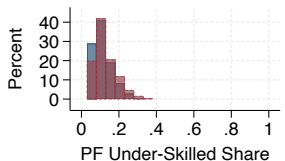
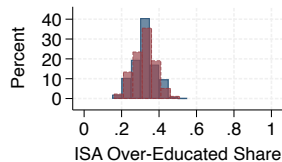
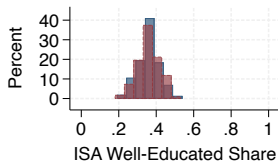
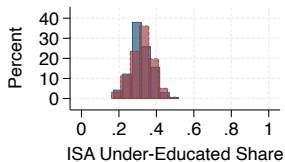
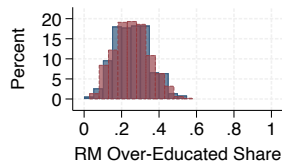
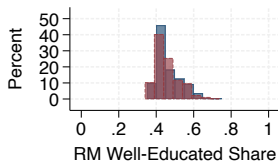
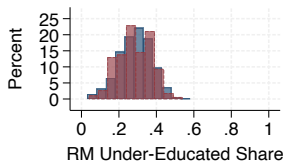


# Education policy: education $\uparrow$ ( $S_2$ )

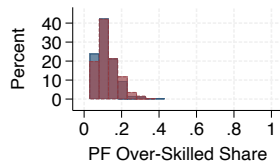
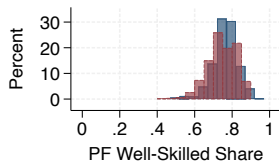
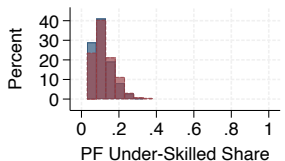
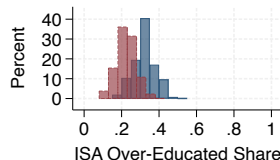
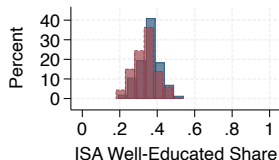
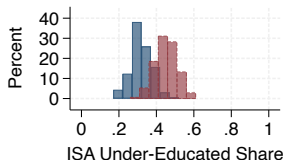
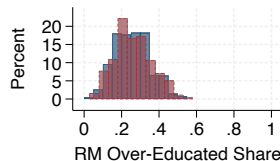
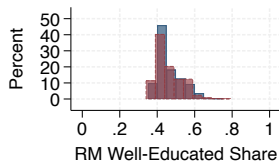
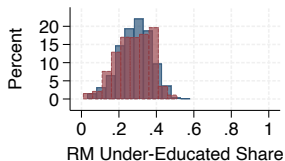




# Change in labour demand: required skill $\uparrow (S_3)$



# Change in labour demand: required education $\uparrow (S_4)$



# References I

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- Zinn, S. et al. (2012). A mate-matching algorithm for continuous-time microsimulation models. *International journal of microsimulation*, 5(1):31–51.