MisMatch in Human Capital Accumulation
International Conference on PIACC

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Education MisMatch

- MisMatch: lack of assortative matching between education and ability
- Why does it matter? Indicative of:
  - efficiency of human capital accumulation: who gets educated?
  - equality of opportunity or discrimination
  - borrowing constraints
- BUT:
  - what exactly is MisMatch? Not directly in any data set!
  - what are its sources?
  - does mismatch imply inefficiency?
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Our Approach

• Set the Stage
  • Planner’s Problem
  • Initial Look at Cross-Country Data
  • Apparent MisMatch

• Quantify MisMatch

• Models to Explain MisMatch

• Estimation

• Robustness
Findings

- MisMatch is prevalent
- Borrowing Constraint and Differences in Tastes across households do not cause Education MisMatch
- Measured MisMatch does not reflect inefficiency in matching of ability and educational attainment
Efficient Allocation

- education attainment depends on innate ability, $\theta$
- Efficient choice:
  - no college if $\theta \leq \theta^*$.
  - college if $\theta > \theta^*$.
  - critical ability, $\theta^*$, determined endogenously
- MisMatch is defined as:
  - Under Match: no college, $\theta > \theta^*$.
  - Over Match: college, $\theta < \theta^*$. 
Data Overview

- OECD survey of adult skills
- 21 Countries: Focus on Germany, Japan, Italy and US
- Ability: PIACC numeracy test score
- Education:
  - below College (ISCED1-4)
  - College (tertiary) and above (ISCED5+) trade and technical included
These figures show the distribution of PIACC scores by education (row) by country (columns). For each country, the first row is less than college and the second row is college and beyond.
Measurement: Under and Over Matching

- Logistic (Reduced Form) Regressions
  - \( e_i = \frac{\exp(\alpha_0 + \alpha_1 test_i)}{1 + \exp(\alpha_0 + \alpha_1 test_i)} \)
  - individual data, by country
  - educational attainment: \( e_i \in \{0, 1\} \)
  - covariates: constant, test score, (parental education)

- under- and over-match
  - predictions from logistic regression
  - study tails of distribution
  - under-match: \( e_i = 0 \cup \text{Prob}(e_i = 1) > 80th \text{ percentile} \)
  - over-match: \( e_i = 1 \cup \text{Prob}(e_i = 1) < 20th \text{ percentile} \)

- model provides an interpretation of these regression results
### Table: Moments

<table>
<thead>
<tr>
<th></th>
<th>college</th>
<th>under-match</th>
<th>over-match</th>
<th>$\alpha_0$</th>
<th>$\alpha_1$</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>0.373</td>
<td>0.104</td>
<td>0.062</td>
<td>$-0.720$</td>
<td>1.160</td>
<td>1440</td>
</tr>
<tr>
<td>Italy</td>
<td>0.230</td>
<td>0.146</td>
<td>0.069</td>
<td>$-1.510$</td>
<td>0.890</td>
<td>1381</td>
</tr>
<tr>
<td>Japan</td>
<td>0.597</td>
<td>0.078</td>
<td>0.108</td>
<td>0.230</td>
<td>0.860</td>
<td>1559</td>
</tr>
<tr>
<td>US</td>
<td>0.455</td>
<td>0.055</td>
<td>0.045</td>
<td>$-0.360$</td>
<td>1.510</td>
<td>1495</td>
</tr>
</tbody>
</table>

This table reports data moments. Standard errors are provided for the logistic coefficient estimates. $N$ is the sample size.
Table: Correlations

<p>| | |</p>
<table>
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<tr>
<td>c(ed,under)</td>
<td>-0.648</td>
</tr>
<tr>
<td>c(ed,over)</td>
<td>0.725</td>
</tr>
</tbody>
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This table provides correlations across the 21 countries. Here ed is the college rate, under is the under-match rate, over is the over-match rate.
Explanations of MisMatch

• taste differences: role models, grit
• borrowing constraints
• noisy test scores: ability known by agent not by researcher
• goal is to understand and ultimately identify sources of MisMatch
Empirical Approach

- **SMM**

\[ \Lambda(\Theta) \equiv (M^d - M^s(\Theta))I(M^d - M^s(\Theta))'. \]  

- **Moments**
  - education rates
  - mismatch
  - coefficients on test scores from wage regressions

- **Parameters**
  - Calibration of some
  - SMM Estimation of key parameters: \( \min_\Theta \Lambda(\Theta) \)

- **Mapping from parameters to simulated moments,** \( M^s(\Theta) \), through economic model
Estimation

- $\Theta = (\phi, \bar{\varepsilon}, \sigma, h(\bar{e}), \bar{b})$
  - $\phi$ is shape parameter for ability distribution
  - $\bar{\varepsilon}$ parameterizes the uniform taste shock
  - $\sigma$ is the noise in the test score
  - $h(\bar{e})$ is the return on education
  - $\bar{b}$ is the borrowing limit per period in education phase
This table reports data and simulated moments for the estimated models. The "No Borrowing" treatment uses the baseline parameter estimates but sets the borrowing limit to zero.

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<th>$\nu_1$</th>
<th>$\nu_2$</th>
<th>fit</th>
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<tr>
<td><strong>Baseline</strong></td>
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<td>0.003</td>
</tr>
<tr>
<td><strong>Estimated Borrowing Constraint</strong></td>
<td></td>
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<tr>
<td><strong>No Borrowing Allowed</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>German</td>
<td>0.139</td>
<td>0.133</td>
<td>0.025</td>
<td>-2.451</td>
<td>1.852</td>
<td>0.217</td>
<td>0.089</td>
<td>3.534</td>
</tr>
<tr>
<td>Italy</td>
<td>0.030</td>
<td>0.180</td>
<td>0.005</td>
<td>-5.101</td>
<td>1.998</td>
<td>0.094</td>
<td>0.018</td>
<td>14.176</td>
</tr>
<tr>
<td>Japan</td>
<td>0.370</td>
<td>0.094</td>
<td>0.082</td>
<td>-0.612</td>
<td>1.082</td>
<td>0.200</td>
<td>0.081</td>
<td>0.812</td>
</tr>
<tr>
<td>US</td>
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<td>0.077</td>
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Findings

- highlight 4 countries, estimate 21
- mismatch explained by
  - mostly by "noisy test scores"
  - a bit from taste shocks
  - not from borrowing constraints
- many robustness checks
- consider alternative structures
Robustness

- Isolating Ability
  - young cohort
  - inferring ability: conditional test scores
  - NLSY
- Parent’s Education as a proxy for taste shock
- Normal Distribution of Taste Shocks
- Alternative Measures of MisMatch

Find:
- Test Score Noise dominates
- No evidence of Borrowing Constraints
Alternative Structures

- Imperfect Information about Ability
- Reverse Causality: education influences test score

Basic Findings are Robust
Other Implications

- Decomposing Returns to College
- Output Loss from MisMatch
- Job vs Education MisMatch
Table: Return to College

| Country | college prem. | $h(\bar{e})$ | $E(\theta|ed = 1)$ | $E(\theta|ed = 0)$ |
|---------|--------------|--------------|-------------------|-------------------|
| Germany | 2.015        | 0.803        | 2.509             | 1.197             |
| Italy   | 1.961        | 0.728        | 2.693             | 1.243             |
| Japan   | 1.852        | 1.227        | 1.509             | 1.067             |
| US      | 2.057        | 1.056        | 1.949             | 1.131             |

The college premium is the ratio of earnings in the late work phase for agents with college and without and $h(\bar{e})$ is the estimated return to college independent of ability.
Final Thoughts

• apparent mismatch is present
• borrowing constraints are not key
• noisy test scores are most important

Policy Implications:

• measured mismatch is not a sign of inefficiency
• not a statement about efficiency of education rates