Meritocracy across Countries

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This Paper

- Labor accounts for around 2/3 of national income & worker-job matching affects aggregate outcomes
  - Micro evidence from LICs: family, networks, political connections and corruption impact the job match
  - But is this quantitatively relevant for cross-country differences in aggregate output?

- To quantify this channel, we use macro development accounting with 2 innovations
  - Model: workers and jobs are heterogeneous production inputs whose matching patterns affect output
  - Data: micro data on heterogeneous workers and jobs, and how they are matched

- Focus on overlooked aspect in the macro development debate: Labor market mismatch of heterogeneous workers and jobs (complementing existing analyses of misallocation of homogeneous K and L)

- **Our Question:** Does worker-job matching on skills—i.e. meritocracy in the labor market—differ across countries and account for economic development?

▸ Literature

Meritocracy in the Labor Market

Are Worker Skills and Job Requirements Matched?

Example

- Two jobs: astrophysics professor; soccer player.
- Two workers: Albert Einstein; Lionel Messi.

Meritocracy in the Labor Market

Are Worker Skills and Job Requirements Matched?

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- Two workers: Albert Einstein; Lionel Messi.



Meritocratic allocation



Mismatched allocation

Meritocracy in the Labor Market

- A country's actual worker-job matching $\mu(x, y)$ and the output-max. matching $\mu^*(x, y)$ are shaped by:
  - endowments: workers' skills (x) and jobs' skill requirements (y)
  - technology: $f(x, y)$
  - idiosyncratic matching frictions

- **Meritocracy:** Workers and jobs sort on productive traits (x, y) to maximize output $f(x, y)$, rather than on other idiosyncratic traits due to matching frictions

$$\text{Meritocracy Index} \quad \mathcal{M} := \frac{\text{Actual Output}}{\text{Potential Output}} = \frac{\sum_{(x,y)} \mu(x, y) f(x, y)}{\sum_{(x,y)} \mu^*(x, y) f(x, y)}$$

- If there are no frictions, then $\mathcal{M} = 1$ independent of endowment and technology
- But if there are frictions, endowment and technology—by impacting the returns to sorting—shape $\mathcal{M}$

Our Main Results

$$\text{Meritocracy Index} \quad \mathcal{M} := \frac{\sum_{(x,y)} \mu(x,y) f(x,y)}{\sum_{(x,y)} \mu^*(x,y) f(x,y)}$$

1. More worker-job matching on productive attributes (x, y) in rich countries, i.e., higher $\mathcal{M}$
2. Just increasing meritocracy, $|\mu(x,y) - \mu^*(x,y)| \downarrow$, by reducing frictions does not help poor countries catch up
3. But increased meritocracy is important for realizing the gains from improved technology and endowments

Empirical Analysis

The Data

Program for International Assessment of Adult Competencies (PIAAC)

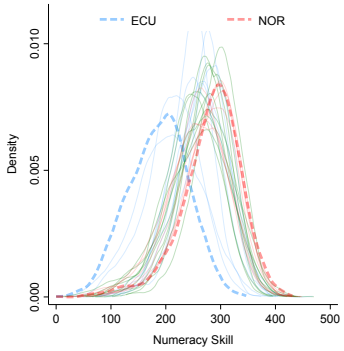
- Representative survey of 29 countries, 2012-2018, ∼5,000 adults in each country
- Development spectrum: Europe, N/S Americas, C/E Asia
- Tests cognitive and workplace skills & skill requirements in an internationally comparable way
- Key variables: ▸ Details
  - Worker Skills: numeracy skill & literacy skill $x = (x_n, x_\ell)$
  - Job Skill Requirements: numeracy & literacy req's + firm size, $y = (y_n, y_\ell, y_s)$

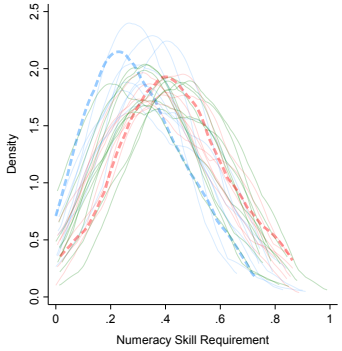
Data Validation

- Pisa Test Scores: Validation of PIAAC skills across countries ▸ PISA
- O*NET: Validation of PIAAC skill requirements by correlating them with requirements from U.S. ▸ ONET
- Jobs of the World Project: Representativeness of PIAAC within and across countries ▸ JWD

Distribution of Worker Skills and Job Skill Requirements

Example: Numeracy



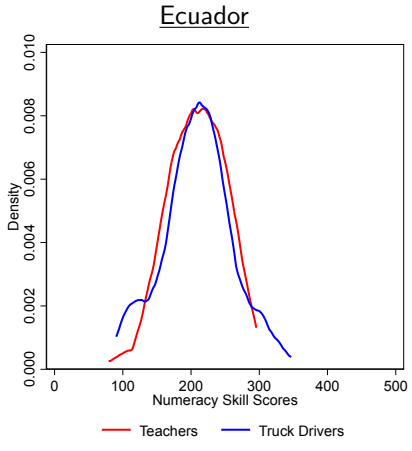


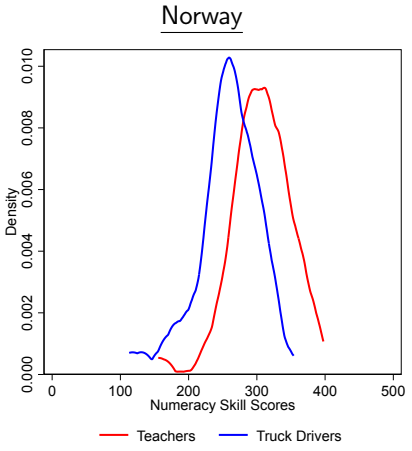
- Richer countries have more skilled workers and more demanding jobs
- Education explains only between 2% and 36% of the within-country variation in numeracy/literacy skills
- Inclusion of skills and skill requirements into Mincer regression increases R^2 by up to 0.2

Data Source: PIAAC.

Less Worker-Job Mismatch in Richer Countries

Illustration: How Different are the Numeracy Skill Distributions of Truck Drivers and Teachers?





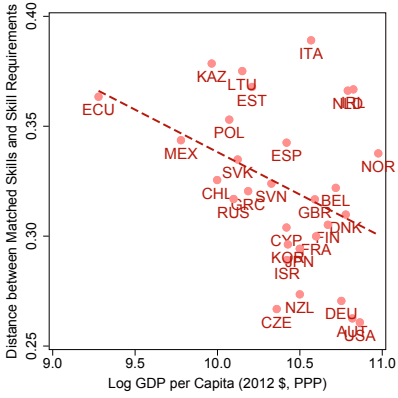
Data Source: PIAAC.

▸ Numeracy Skill Req's ▸ Literacy Skills ▸ All countries

Less Worker-Job Mismatch in Richer Countries

Main Fact

$$\text{Worker-Job Mismatch} := \|(x_n, x_\ell) - (y_n, y_\ell)\|_2$$

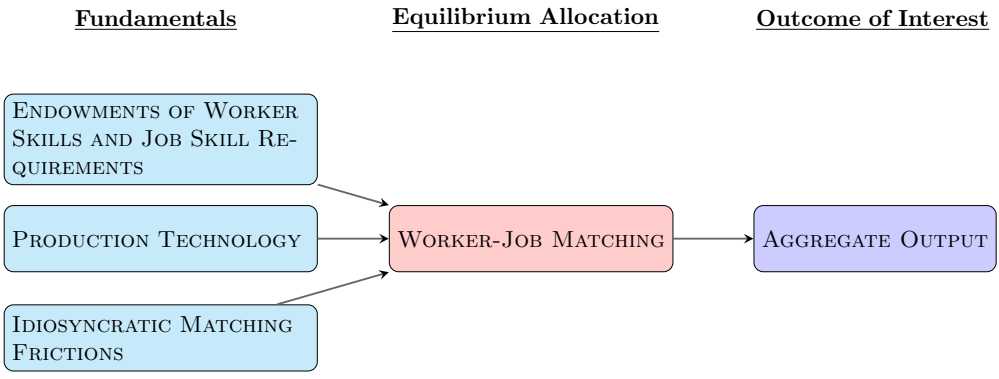


Data Source: PIAAC. Notes: Based on $[0, 1]$-rescaled skills and skill requirements.

▸ Other Measures ▸ By Sector

The Model

Model Overview



The Model

Country-Specific Ingredients

- Endowments:
  - Workers: discrete types, $x = (x_n, x_\ell, x_g) \sim G(x_n, x_\ell, x_g)$, risk neutral, mass $m^W = 1$
  - Jobs: discrete types, $y = (y_n, y_\ell, y_s) \sim H(y_n, y_\ell, y_s)$, risk neutral, mass m^J
- Technology:
  - Labor Market Production Technology: match $((x_n, x_\ell), (y_n, y_\ell, y_s))$ produces

$$f(x_n, x_\ell, y_n, y_\ell, y_s) = \alpha_{nn} x_n y_n + \alpha_{n\ell} x_n y_\ell + \alpha_{ns} x_n y_s + \alpha_{\ell n} x_\ell y_n + \alpha_{\ell\ell} x_\ell y_\ell + \alpha_{\ell s} x_\ell y_s,$$

  - Home Production Technology (Outside Options): when unmatched

$$\begin{aligned} f_{x\emptyset}(x_n, x_\ell, x_g) \quad & \text{Workers} \\ f_{\emptyset y}(y_n, y_\ell, y_s) = 0 \quad & \text{Jobs} \end{aligned}$$

- Idiosyncratic Matching Frictions: $\delta_{iy}, \delta_{xk} \sim \text{Type I}(0, \sigma)$, $\forall\ i$ over all y and $\forall\ k$ over all x

Equilibrium

An equilibrium consists of

- matching frequencies $\mu(x, y)$
- systematic and idiosyncratic wages $(w(x, y), \tilde{w}(x_i, y))$ and profits $(\pi(x, y), \tilde{\pi}(x, y_k))$

s.t. each job k of type y, and each worker i of type x matches to maximize their payoffs given $(\delta_{iy}, \delta_{xk})$

$$\text{Job:} \quad \max\Big\{ \max_x \underbrace{\pi(x,y) + \delta_{xk}}_{\tilde{\pi}(x,y_k)},\ f_{\emptyset y} + \delta_{\emptyset k} \Big\} \qquad \to \qquad \mu^J(x,y)$$

$$\text{Worker:} \quad \max\Big\{ \max_y \underbrace{w(x,y) + \delta_{iy}}_{\tilde{w}(x_i,y)},\ f_{x\emptyset} + \delta_{i\emptyset} \Big\} \qquad \to \qquad \mu^W(x,y)$$

and the labor market clears

$$\mu(x,y) = \mu^W(x,y) = \mu^J(x,y)$$

▸ Model Details

Identification and Estimation

Identification of Country-Specific Parameters

- Need to identify for each country the parameter vector

$$\theta := \left(H, G, m^J, f, f_{x\emptyset}, \sigma\right)$$

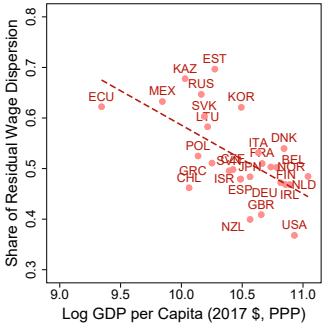
Proposition

The model is identified—i.e., there exists a unique θ that rationalizes data on worker skill & job skill requirement distributions, sorting patterns, within-(x, y)-match wage dispersion, and profit shares.

- Main challenge: separately identify matching frictions σ and production technology f
- Within-(x, y)-match wage dispersion $\rightarrow$ matching friction σ
- Worker-job sorting patterns $\rightarrow$ production function $(\alpha_{nn}, \alpha_{n\ell}, \alpha_{ns}, \alpha_{\ell n}, \alpha_{\ell\ell}, \alpha_{\ell s})$ in f

Key Estimates I: Idiosyncratic Matching Friction

Data Moment: Residual Wage Dispersion

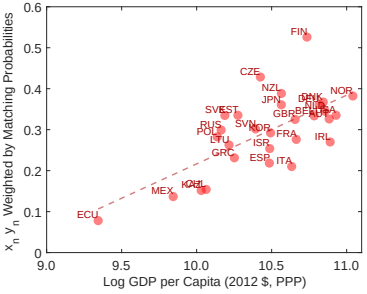


Model Estimate: Idiosyncratic Matching Friction

▸ Wage Dispersion: Robustness

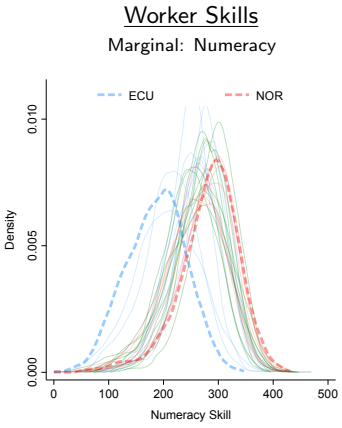
Key Estimates II: Production Technology

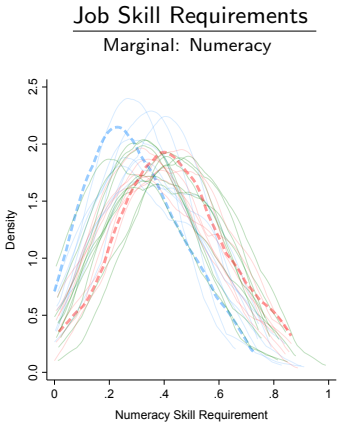
Data Moment: Worker-Job Sorting

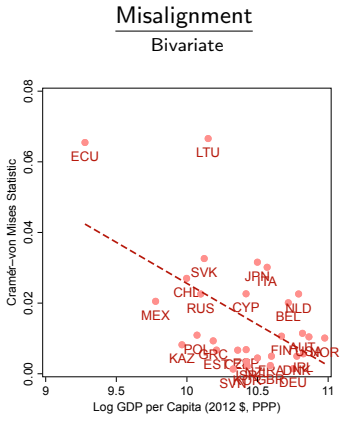


▸ Detailed Estimates

Key Estimates III: Endowments

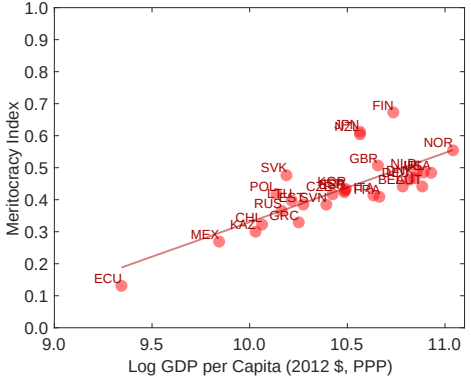






How Does Meritocracy in the Labor Market Differ Across Countries?

$$\mathcal{M}(G,H,f,\sigma) = \frac{\sum_{(x,y)} \mu(x,y) f(x,y)}{\sum_{(x,y)} \mu^*(x,y) f(x,y)}$$

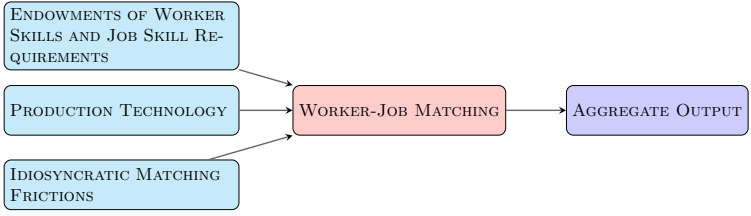


Quantitative Analysis:
Counterfactuals

Counterfactual Experiments

1. Sources: What is the most important factor behind differences in worker-job matching across countries: idiosyncratic matching frictions, technology, or endowments?

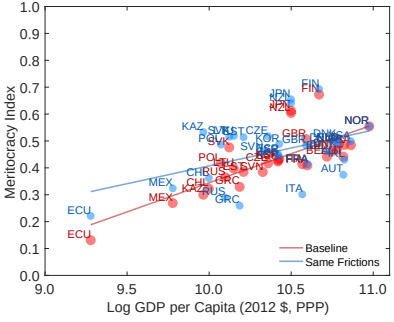
2. Consequences: What is the role of worker-job matching in countries' aggregate output?



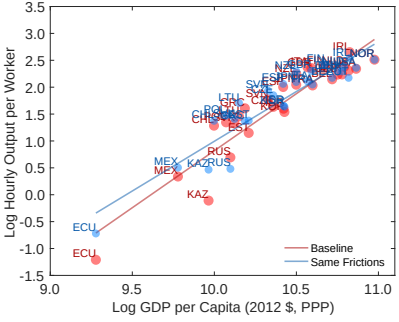
Counterfactual I: Lowering Idiosyncratic Matching Frictions

Impose Norway's Matching Frictions across all Countries

Worker-Job Matching



Output per Worker

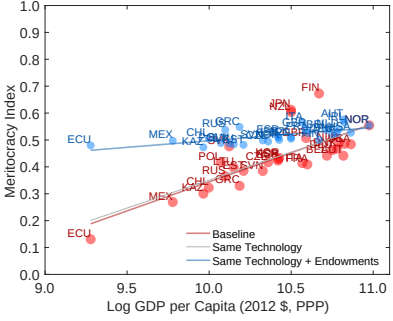


▸ Details

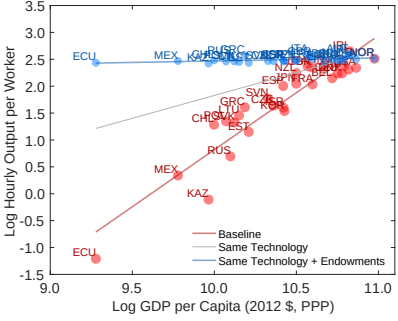
Counterfactual II: Improving Endowments & Technology

Impose Norway's Endowments & Technology across all Countries

Worker-Job Matching

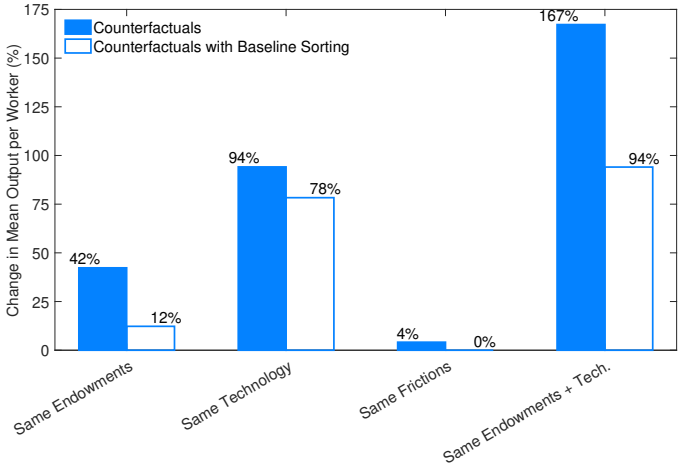


Output per Worker

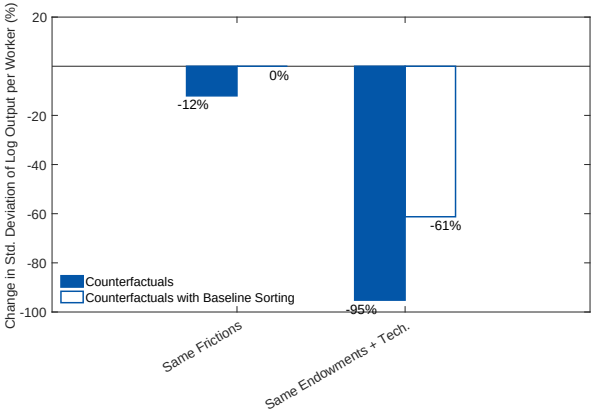


▸ Details

Indirect Role of Frictions



Main Takeaways



1. Increasing meritocracy by only reducing frictions does not help poor countries catch up
2. But increased meritocracy is key to unlocking the gains from development through improved (f, G, H)

▸ Extra

Conclusion

Main Insight

- How important is meritocracy in the labor market for a country's economic development?
  - Richer countries have more meritocratic labor markets.
  - The lack of meritocracy in itself is not associated with underdevelopment.
  - But meritocracy boosts development due to improved technology and endowments since they increase the returns to worker-job matching.

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Appendix

The Literature

- Distortions in the Worker-Job Matching in Low-Income Countries
  - Political Connections and Private Sector Jobs: Amodio, Chiovelli, Hohmann '24; Fafchamps, Labonne '17.
  - Networks and Referrals: Beaman, Magruder '12
  - Family Connections, Nepotism and Family Firms: Bertrand, Schoar '06; Akcigit, Alp, Peters '21
  - Corruption: Kristiansen and Ramli '06; Weaver '21

- Macro Development Accounting
  - Development Accounting (broadly):Hall, Jones '99; Caselli '05, Hsieh, Klenow '09, '10; Restuccia, Rogerson '08
  - Technology:Caselli, Coleman '06; Caselli '16; Comin, Mestieri '18; Caselli, Ciccone '19; Malmberg '22; Rossi '22
  - Distribution of Workers (human capital): Jones '14, '19; Hendricks, Schoellman '18, '21
  - Distribution of Occupations (task intensity): Lewandowski, Park, Hardy, Yang '19; Caunedo, Keller, Shin '22

- Sorting and Mismatch
  - Muti-Dimensional Matching: Lindenlaub '17; Lindenlaub, Postel-Vinay '23
  - Idiosyncratic Shocks: Choo, Siow '06; Galichon, Salanie 2022
  - Output Losses from Mismatch: Hagedorn, Law, Manovskii '17, Bagger, Lentz '19, Lise, Postel-Vinay '20

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Skills and Skill Requirements

Variable Construction

- Objectives
  1. Discretize skills and skill requirements to align model with data
  2. Make units of skills and skill requirements comparable
  3. Preserve differences in these skills and skill requirements across countries
- Skills
  - Rank all workers in our data *globally* according to their numeracy and also literacy skills
  - In each *country*, construct skill quintiles
  - Attach to each country's quintiles the average global rank of its workers

    $\rightarrow$ Skill distribution contained in $[0,1]^2$, while preserving cross-country differences
- Skill Requirements
  - Same as for skills
  - But with pre-step: average reported skill requirements at the occupation level

    $\rightarrow$ Skill requirement distribution contained in $[0,1]^2$, while preserving cross-country differences

Skill Test Scores $\rightarrow$ Worker Skills

Example: Numeracy Skills

1. simple processes such as counting, sorting, performing basic arithmetic operations (e.g. %) ($<$**176**).
2. understand basic mathematical processes in common, concrete/explicit contexts (**176-225**).
3. identify and act on mathematical information embedded in common contexts (**226-275**).
4. understand mathematical information which may be less clear, in unfamiliar contexts (**276-325**).
5. understand complex mathematical information and ideas, may involve chained processes (**326-375**).
6. understand abstract mathematical/statistical ideas, embedded in complex texts (**376-500**).

Number and Difficulty of Performed Tasks → Job Skill Requirements

Example: Numeracy Skill Requirements

1. use a calculator (difficulty: 1)
2. use or calculate fractions or percentages (difficulty: 1.5)
3. prepare charts, graphs or tables (difficulty: 1.5)
4. calculate costs or budgets (difficulty: 3)
5. use simple algebra or formulas (difficulty: 4)
6. use advanced math or statistic (difficulty: 5)

→ sum number of tasks each worker completes weighted by its difficulty

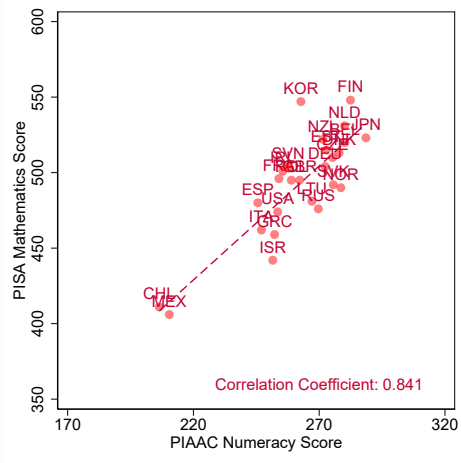
→ average this measure across all workers in a given occupation

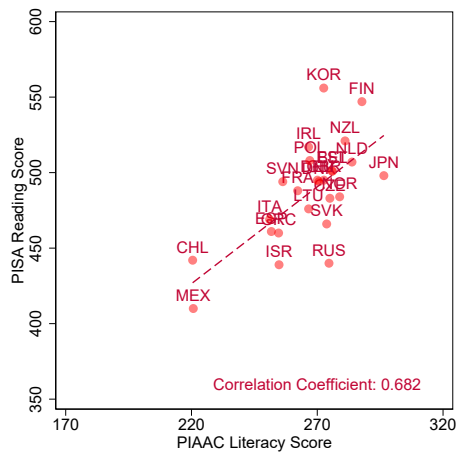
Summary Statistics

	Mean	Min	P25	P50	P75	Max
Panel A: Country Characteristics						
GDP per Capita (PPP)	37,000	11,424	26,957	35,950	47,082	62,399
Population (Millions)	25.53	0.67	2.57	6.94	25.92	284.86
Share of Women	0.53	0.50	0.51	0.52	0.54	0.56
Age	39.00	35.92	38.71	39.13	39.88	40.81
Hourly Wage	14.33	4.79	8.96	15.05	19.07	24.76
Number of Observations	4,302	2,854	3,680	4,008	4,620	7,159
Panel B: Labor Supply						
Numeracy Skill	260.41	186.22	252.98	264.97	276.66	293.67
Literacy Skill	265.45	195.39	256.08	272.10	276.93	302.88
Years of Schooling	12.79	10.50	12.23	12.92	13.44	14.90
Share of the Employed	0.70	0.45	0.64	0.72	0.78	0.82
Share of the Employed among Women	0.63	0.37	0.55	0.69	0.76	0.78
Panel C: Labor Demand						
Numerical Skill Requirement	1.00	0.84	0.95	1.00	1.04	1.25
Literacy Skill Requirement	1.27	1.03	1.18	1.25	1.39	1.50
Share of Firms with $>$ 50 Workers	0.29	0.10	0.25	0.29	0.35	0.42

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Correlation of PISA and PIAAC Skills

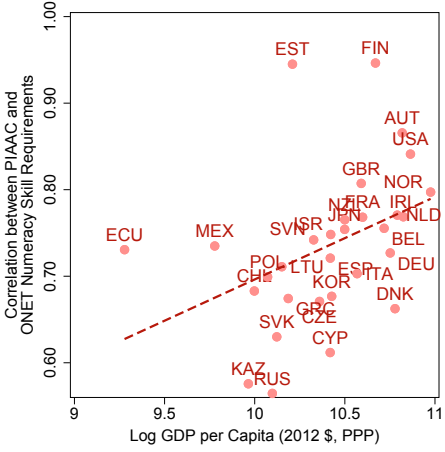


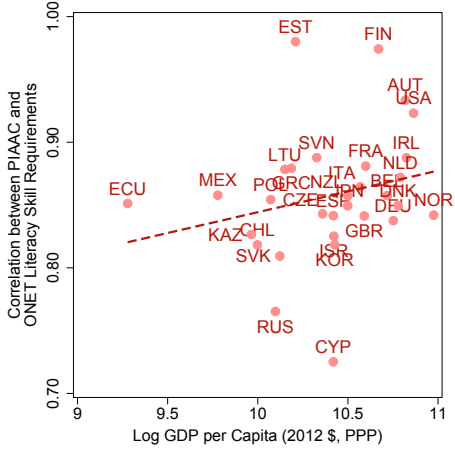


Data Sources: PIAAC and PISA.

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Correlation of ONET and PIAAC Skill Requirements

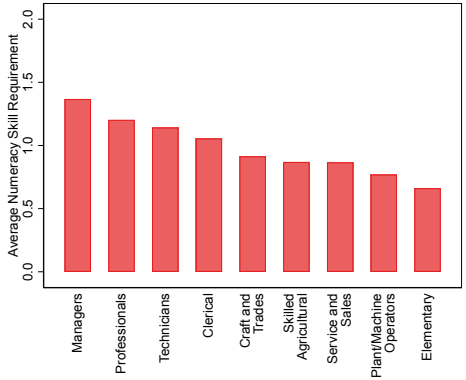


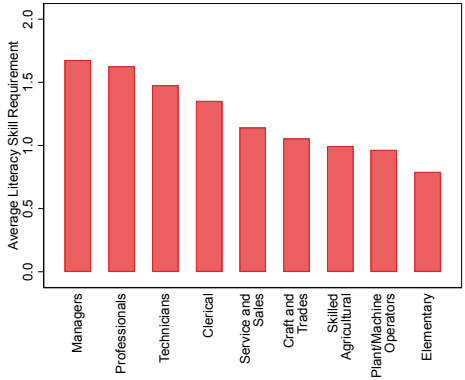


Data Sources: PIAAC and ONET.

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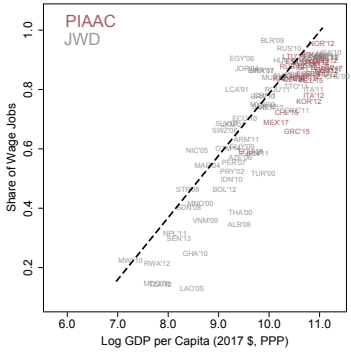
PIAAC Skill Requirements across Broad Occupations

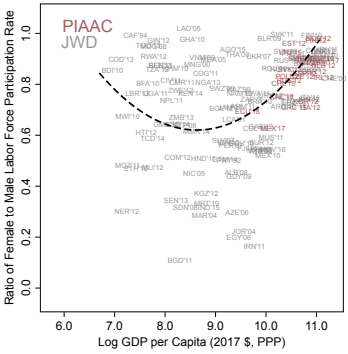


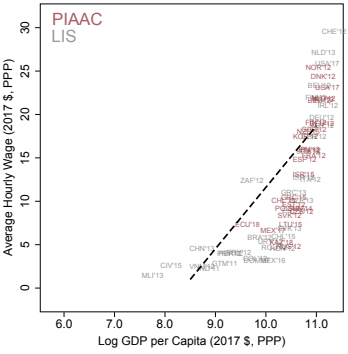


Data Sources: PIAAC and ONET.

Comparison between PIAAC and Jobs of the World Database





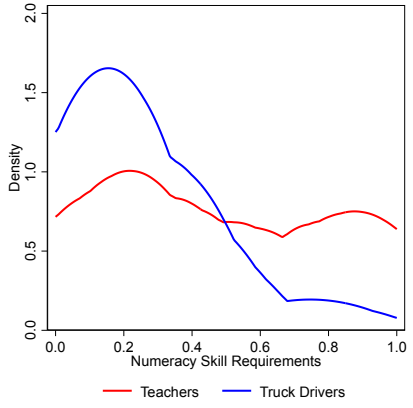


Data Sources: PIAAC, Jobs of the World Database (JWD), and Luxembourg Income Study (LIS).

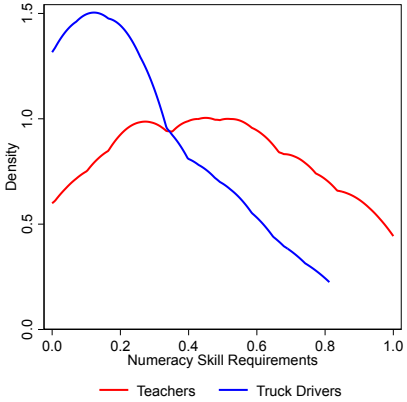
More Worker-Job Matching in Richer Countries

Illustration: How Different are the Skill Distributions of Truck Drivers and Teachers?

Ecuador



Norway

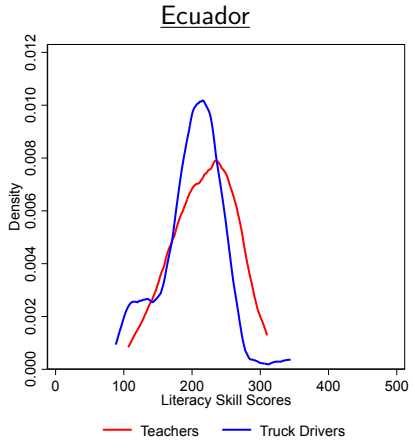


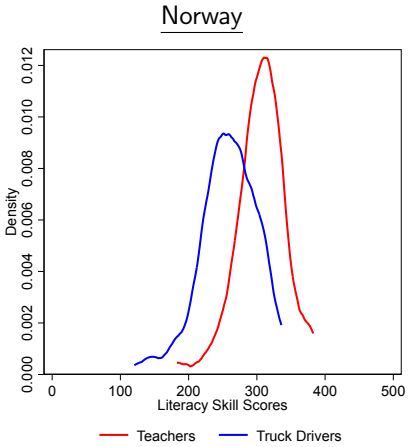
Data Source: PIAAC.

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More Worker-Job Matching in Richer Countries

Illustration: How Different are the Skill Distributions of Truck Drivers and Teachers?





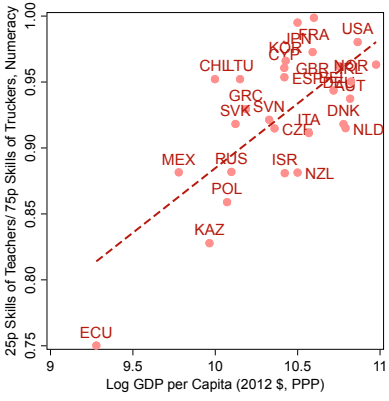
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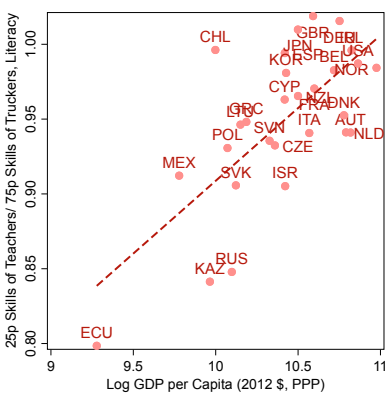
Less Worker-Job Mismatch in Richer Countries

Illustration: How Different are the Skill Distributions of Truck Drivers and Teachers?

Numeracy



Literacy

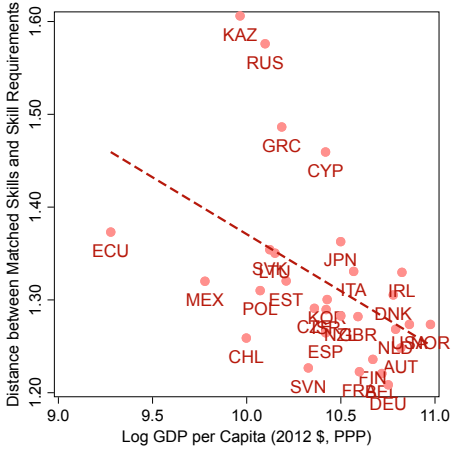


Data Source: PIAAC.

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Less Worker-Job Mismatch in Richer Countries

Robustness I: Euclidean Distance Based on Z-Scores



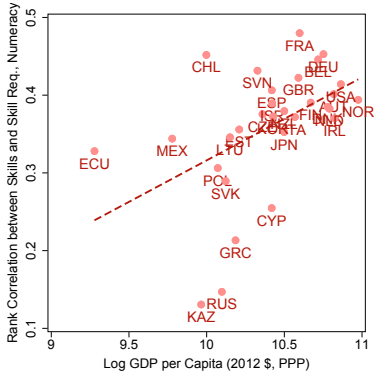
Data Source: PIAAC. Notes: Marginals of x and y transformed into Z-scores.

Back

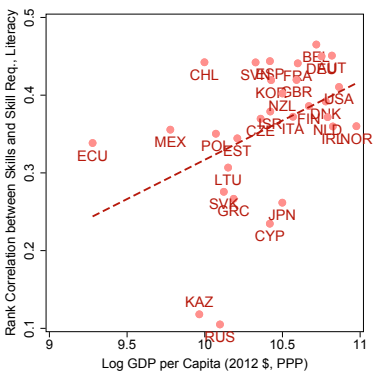
Less Worker-Job Mismatch in Richer Countries

Robustness II: Rank Correlation

Numeracy



Literacy



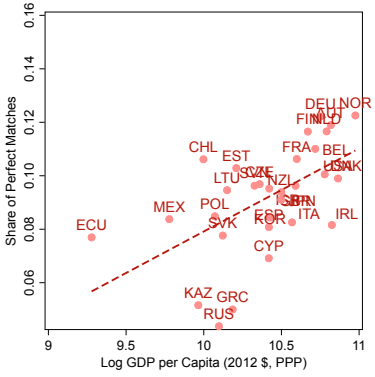
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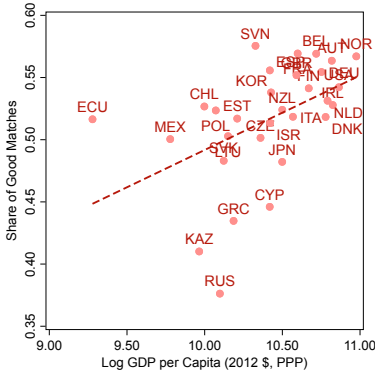
Less Worker-Job Mismatch in Richer Countries

Robustness III: Perfect and Good Matches

Perfect Worker-Job Matches



Good Worker-Job Matches

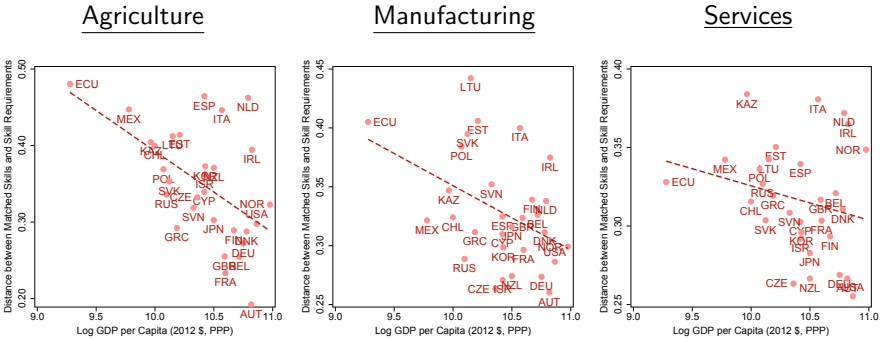


Data Source: PIAAC.

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Less Worker-Job Mismatch in Richer Countries

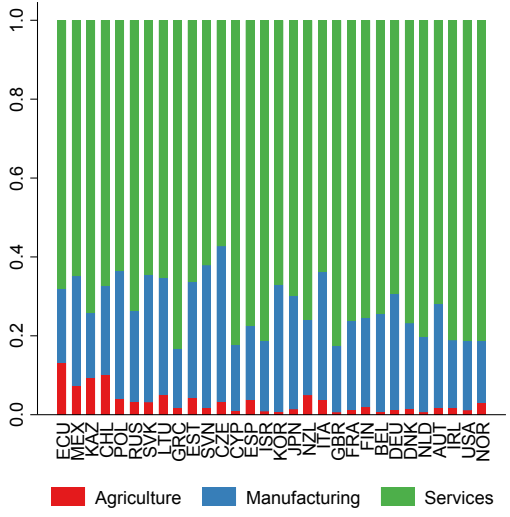
Robustness IV: By Sector



Data Source: PIAAC.

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Sectorial Composition

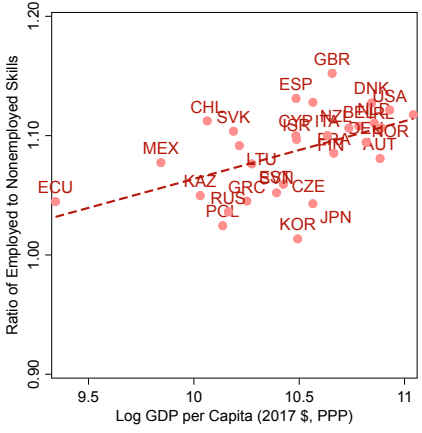


Data Source: PIAAC.

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More Worker-Job Matching in Richer Countries

Extensive Margin

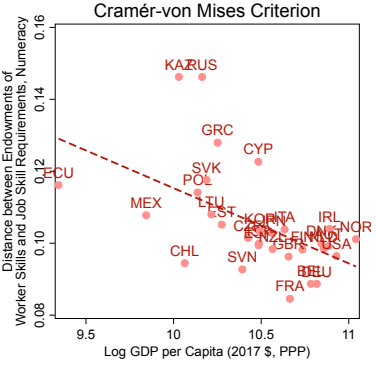


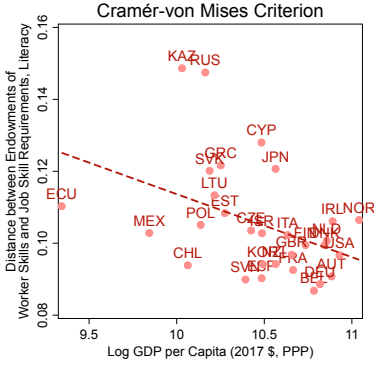
Data Source: PIAAC.

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Larger Distance between Skill and Skill Requirements in Poorer Countries

Robustness: Cramer von Mises Distance



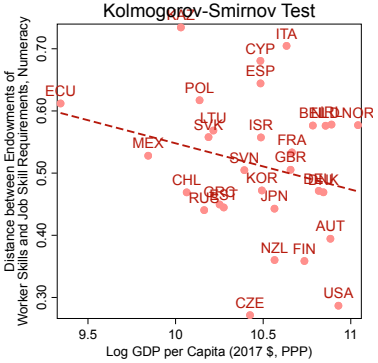


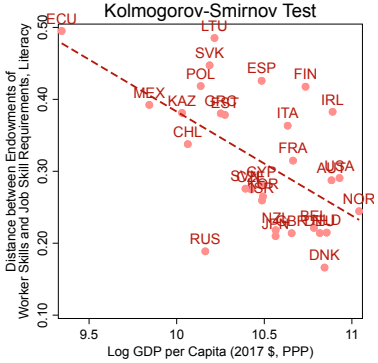
Data Source: PIAAC.

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Larger Distance between Skill and Skill Requirements in Poorer Countries

Robustness: Kolmogorov-Smirnov Distance

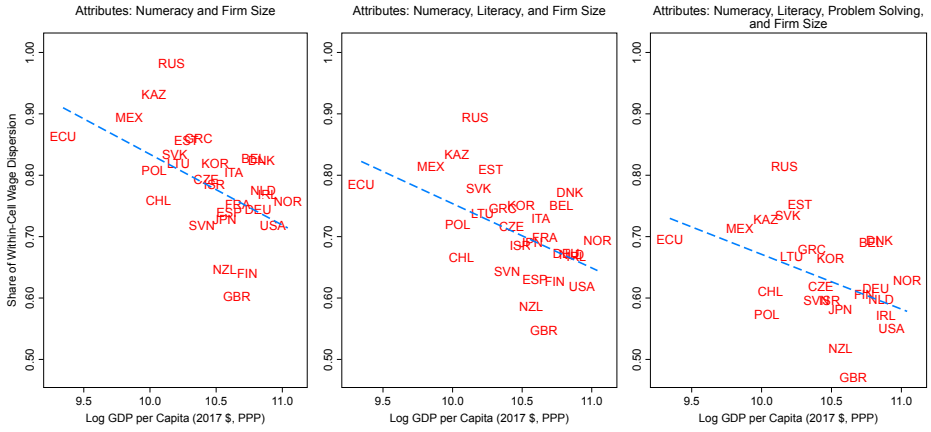




Data Source: PIAAC.

More Residual Wage Dispersion in Poorer Countries

Robustness: Omitted Variables



Data Source: PIAAC.

Equilibrium Properties I

Worker-Job Allocation

- Conditional choice probabilities of worker of type x

$$\mu_{y|x} := \frac{\mu^W(x,y)}{h_x m^W} = \frac{\exp(w(x,y)/\sigma)}{\exp(f_{x\emptyset}(x)/\sigma) + \sum_{\tilde{y}\in\mathcal{Y}} \exp(w(x,\tilde{y})/\sigma)}$$

$$\mu_{\emptyset|x} := \frac{\mu^W(x,\emptyset)}{h_x m^W} = \frac{\exp(f_{x\emptyset}(x)/\sigma)}{\exp(f_{x\emptyset}(x)/\sigma) + \sum_{\tilde{y}\in\mathcal{Y}} \exp(w(x,\tilde{y})/\sigma)}$$

- Conditional choice probabilities of job of type y

$$\mu_{x|y} := \frac{\mu^J(x,y)}{g_y m^J} = \frac{\exp((f(x,y) - w(x,y))/\sigma)}{\exp(f_{\emptyset y}(y)/\sigma) + \sum_{\tilde{x}\in\mathcal{X}} \exp((f(\tilde{x},y) - w(\tilde{x},y))/\sigma)}$$

$$\mu_{\emptyset|y} := \frac{\mu^J(\emptyset,y)}{g_y m^J} = \frac{\exp(f_{\emptyset y}(y)/\sigma)}{\exp(f_{\emptyset y}(y)/\sigma) + \sum_{\tilde{x}\in\mathcal{X}} \exp((f(\tilde{x},y) - w(\tilde{x},y))/\sigma)}$$

- Matching Frequencies

$$\mu(x,y) = \mu^J(x,y) = \mu^W(x,y) = \exp\left(\frac{f(x,y) - f_{x\emptyset}(x) - f_{\emptyset y}(y)}{2\sigma}\right)\sqrt{\mu(x,\emptyset)\mu(\emptyset,y)}$$

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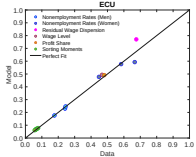
Equilibrium Properties II

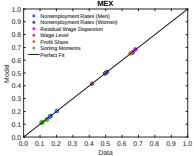
Wages

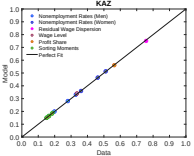
$$\tilde{w}(x_i, y) = w(x, y) + \delta_{iy} = \underbrace{\frac{\sigma}{2} \log\left(\frac{\mu(\emptyset, y)}{\mu(x, \emptyset)}\right) + \frac{f(x, y) + f_{x\emptyset}(x) - f_{\emptyset y}(y)}{2}}_{= w(x,y)} + \delta_{iy}$$

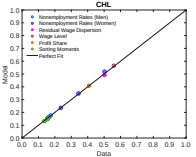
Model Fit I

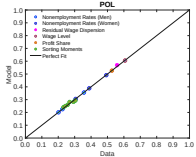
All Countries

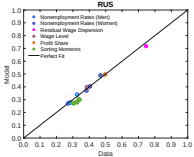


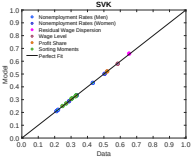


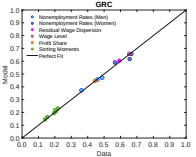


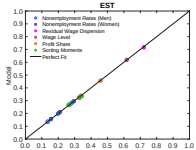


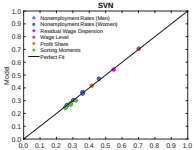


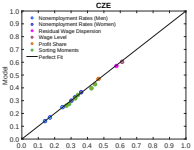


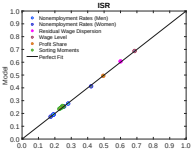






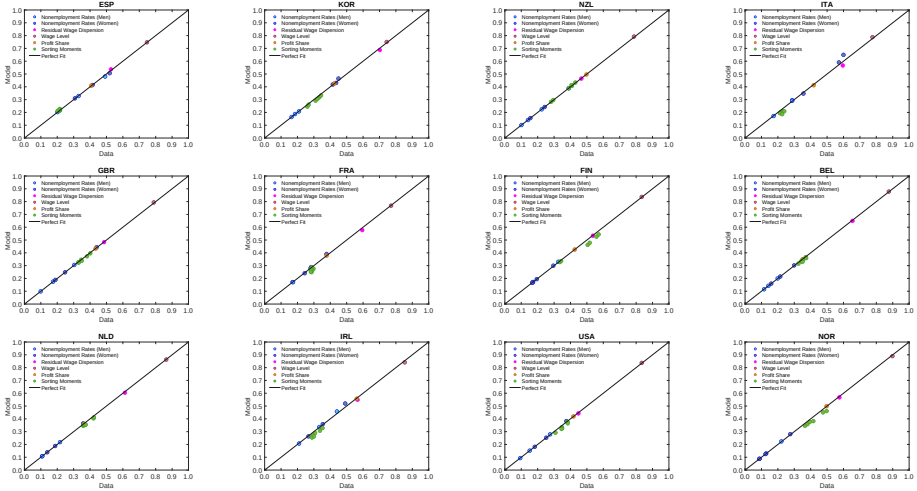






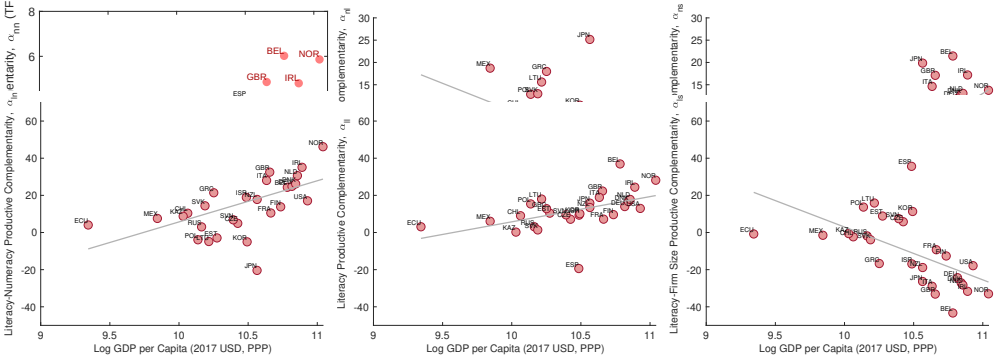
Model Fit II

All Countries



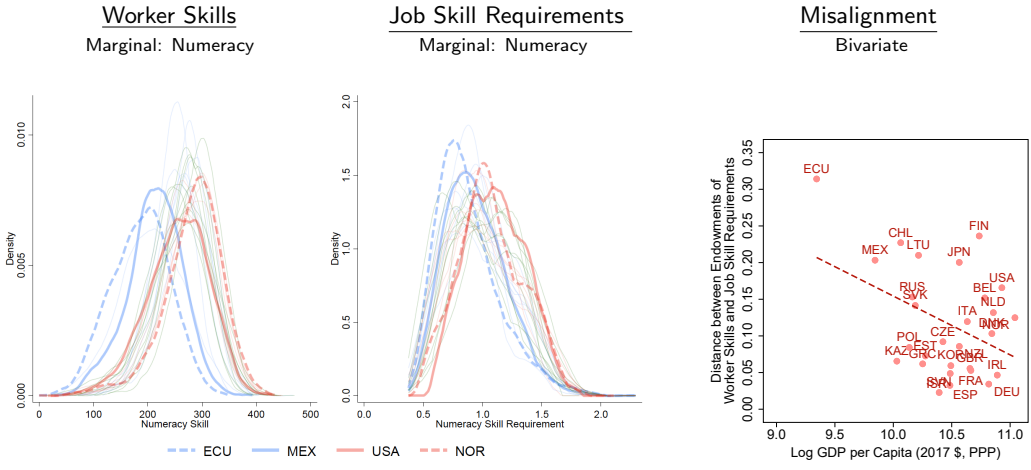
Detailed Estimates I

Production Function



Detailed Estimates II

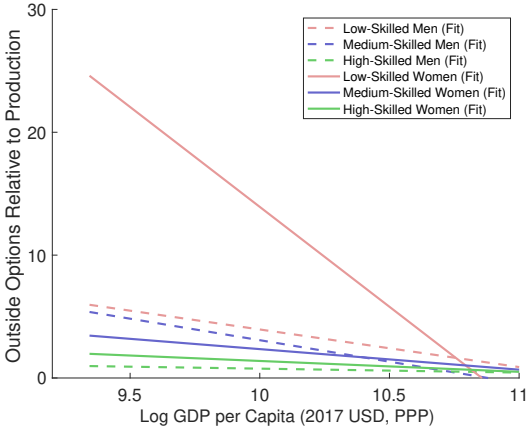
Endowments

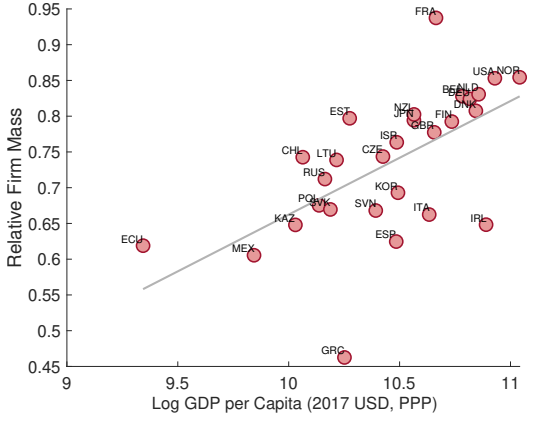


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Detailed Estimates III

Outside Option and Firm Mass

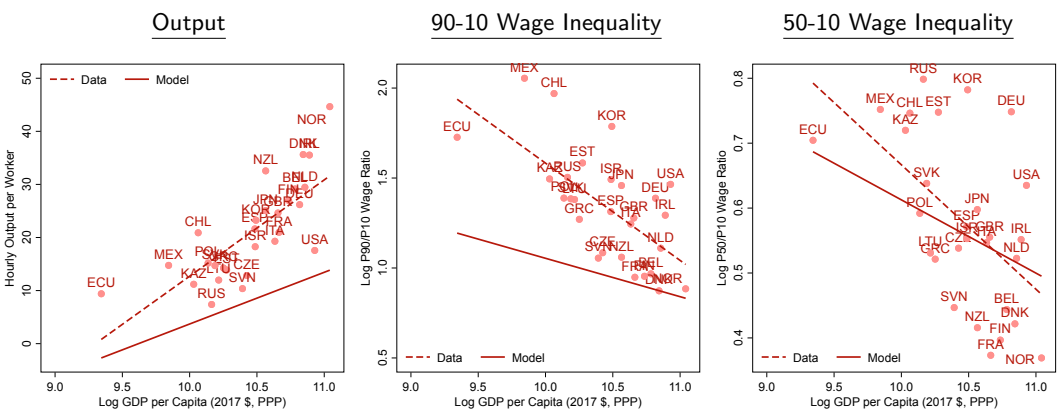




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Non-Targeted Moments – Model Validation

Cross-Country Heterogeneity in Aggregate Outcomes: GDP, Wage Inequality, Skill Returns



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Determinants of Meritocracy in the Labor Market

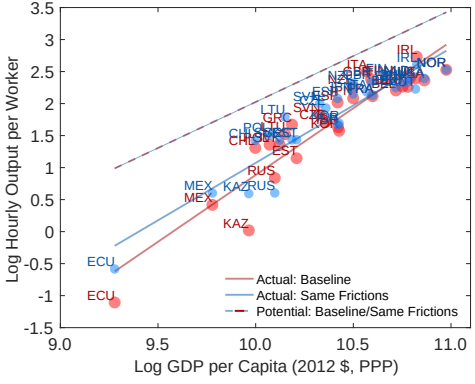
$$\mathcal{M}(G, H, f, \sigma) = \frac{\sum_{(x,y)} \mu(x,y) f(x,y)}{\sum_{(x,y)} \mu^*(x,y) f(x,y)}$$

- Meritocracy: Workers and jobs sort on (x, y) to maximize output rather than on non-productive attributes

1. Matching Frictions σ: guide importance of non-productive attributes in the matching process
2. Technology f: complementarities between (x, y) in f determine the payoff from sorting on (x, y)
3. Endowments G, H: over/under-supply of skills/skill requirements determine how easy it is to sort on (x, y)

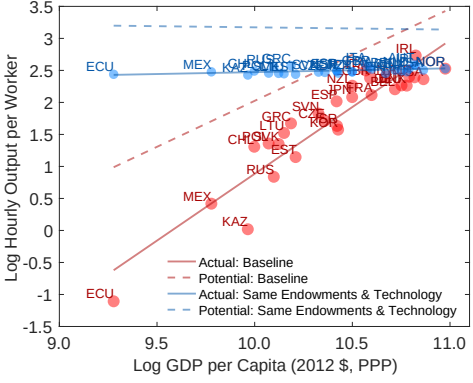
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Why are the Output Gains in Poor Countries Relatively Small?



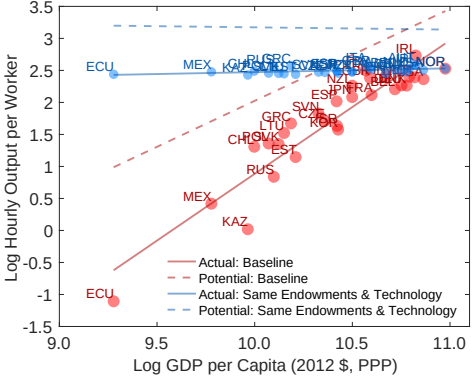
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Why are the Output Gains in Poor Countries Relatively Large?



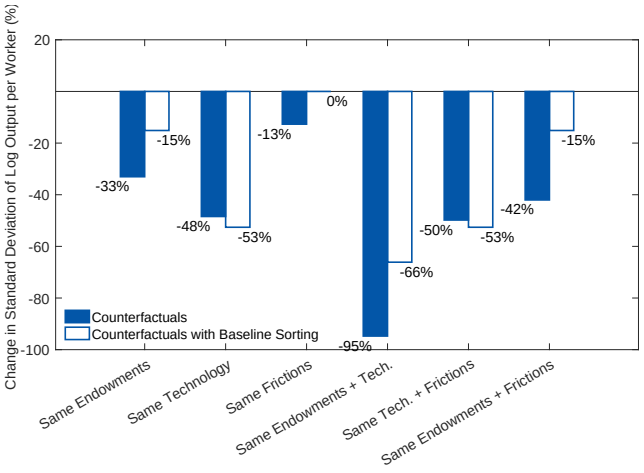
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Why are the Output Gains in Poor Countries Relatively Large?



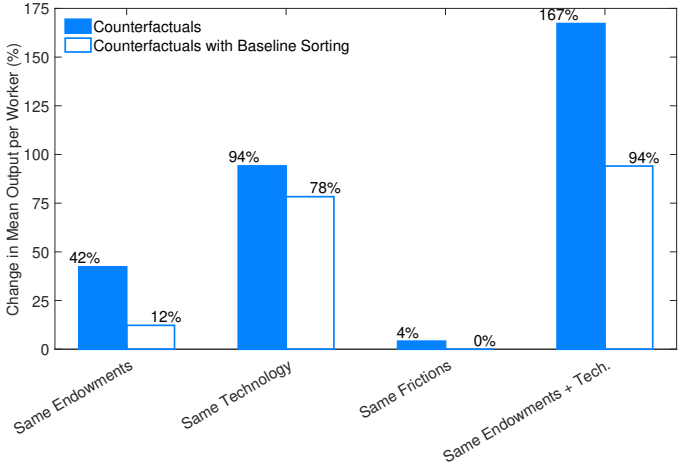
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Main Takeaways



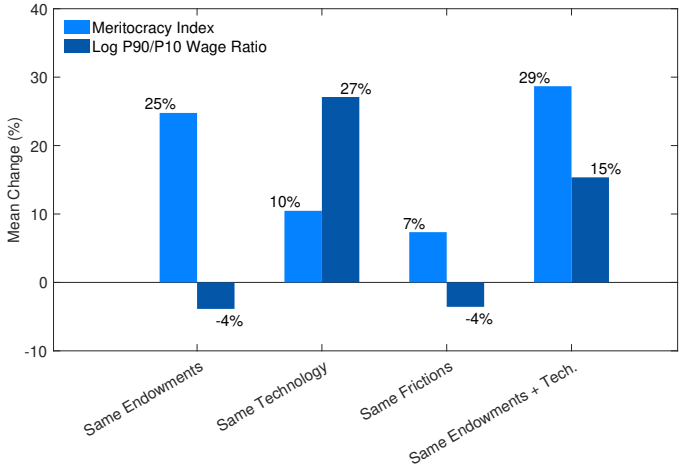
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Main Takeaways



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Meritocracy and Wage Inequality



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