Education Quality and Development Accounting

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Question

Cross-country differences in output per worker are large.

- $y_{90}/y_{10} \approx 22$

How much of the large differences in output per worker are accounted for by differences in quality-adjusted years of schooling?

Development Accounting Approach

Development accounting approach:

$$y = Ak^{\alpha}h^{1-\alpha}$$

- Literature: $h(S)$ accounts for less than 10% of y

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Contribution: $h(S, Q)$. Two challenges:

- Q is unknown
- $h(S, Q)$ is unknown

Outline of Paper

Make progress in four steps:

1. Measure returns to schooling of immigrants
2. Interpret as measure of education quality
3. Parameterize h
4. Conduct development accounting

Preview of Main Results

Results for four steps:

1. Measure returns to schooling of immigrants
   - Returns vary, correlated with output per worker
2. Interpret as measure of education quality
   - Not selection
3. Parameterize h
4. Conduct development accounting
   - Accounts for 20% of y (vs. 10% in literature)

Literature

Three literatures:

- Development accounting (Hall and Jones 1999; Bils and Klenow 2000; Caselli 2005)
- Education quality (Card and Krueger 1992: Hanushek and Kimko 2000; Manuelli and Seshadri 2014)
- Immigrants and human capital (Hendricks 2002)

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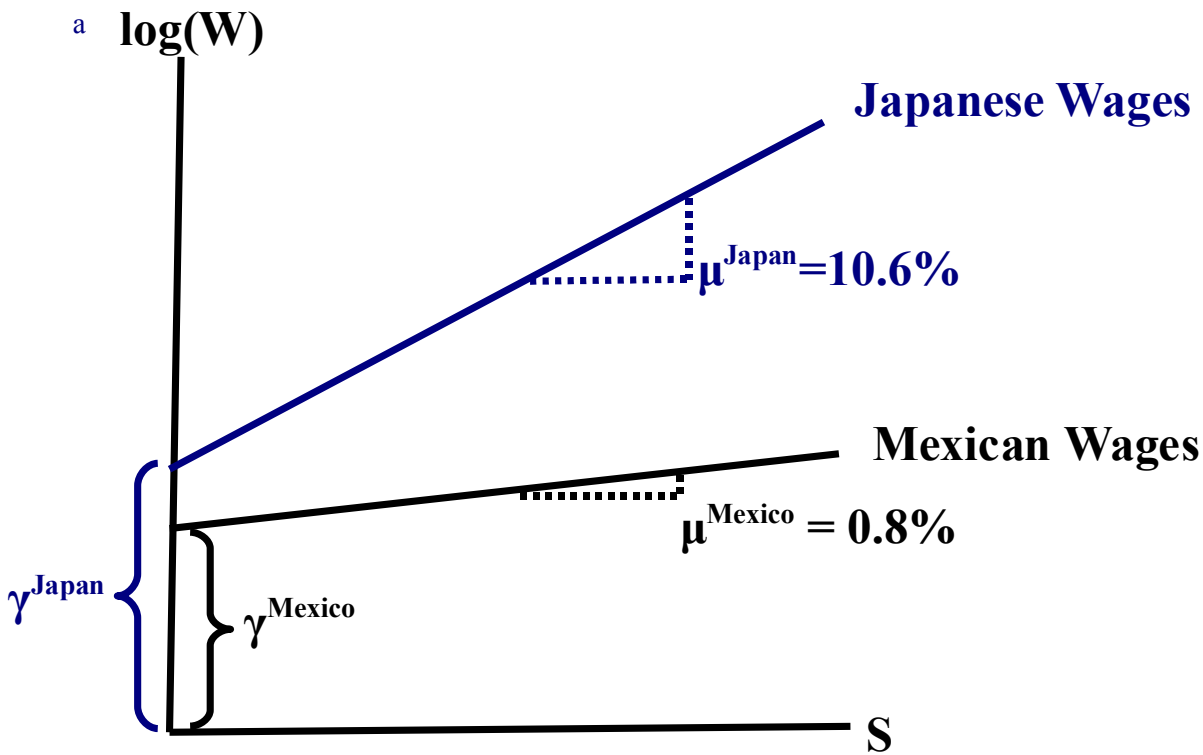
Augmented Mincer Wage Equation

$$\log(W_{US}^{j,k}) = \gamma_{US}^{j} + \mu_{US}^{j} S_{US}^{j,k} + \beta X_{US}^{j,k} + \varepsilon_{US}^{j,k}$$

- Superscripts: immigrant k from country j
- Subscripts: observed in US
- W: wages
- γ_{US}^{j}, μ_{US}^{j}: level and slope of wages for country j immigrants
- S: years of schooling
- X: standard controls

Estimation: Level and Slope of Log-Wages



Sample and Controls

2000 U.S. Census. Sample selection:

- Employed for wages, 30+ hours, 30+ weeks
- Foreign educated

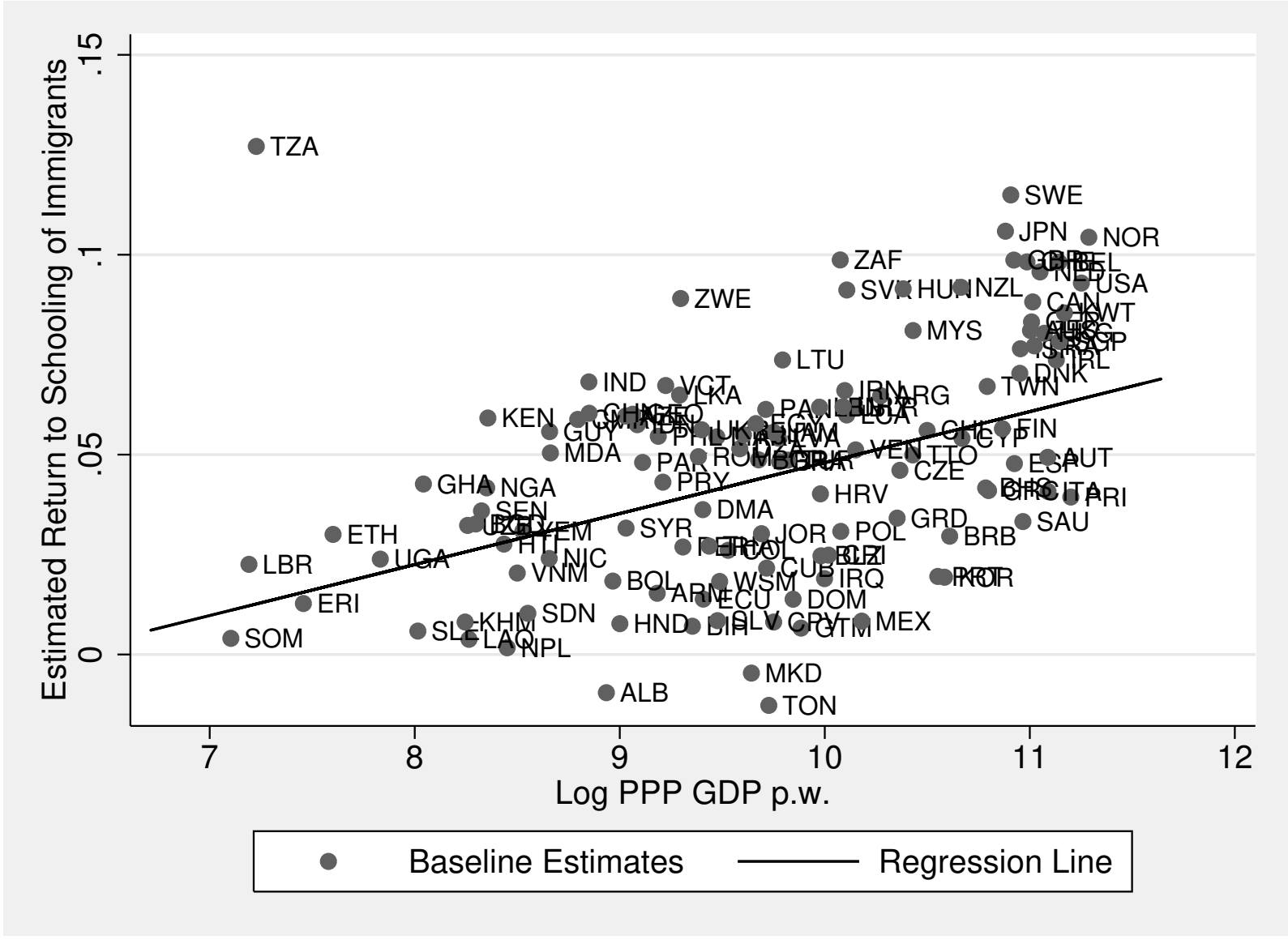
Controls:

- School, age, census region, metro, disability, gender
- English ability, year of immigration

Large sample:

- 240,000 immigrants from 130 countries

Returns and Output per Worker



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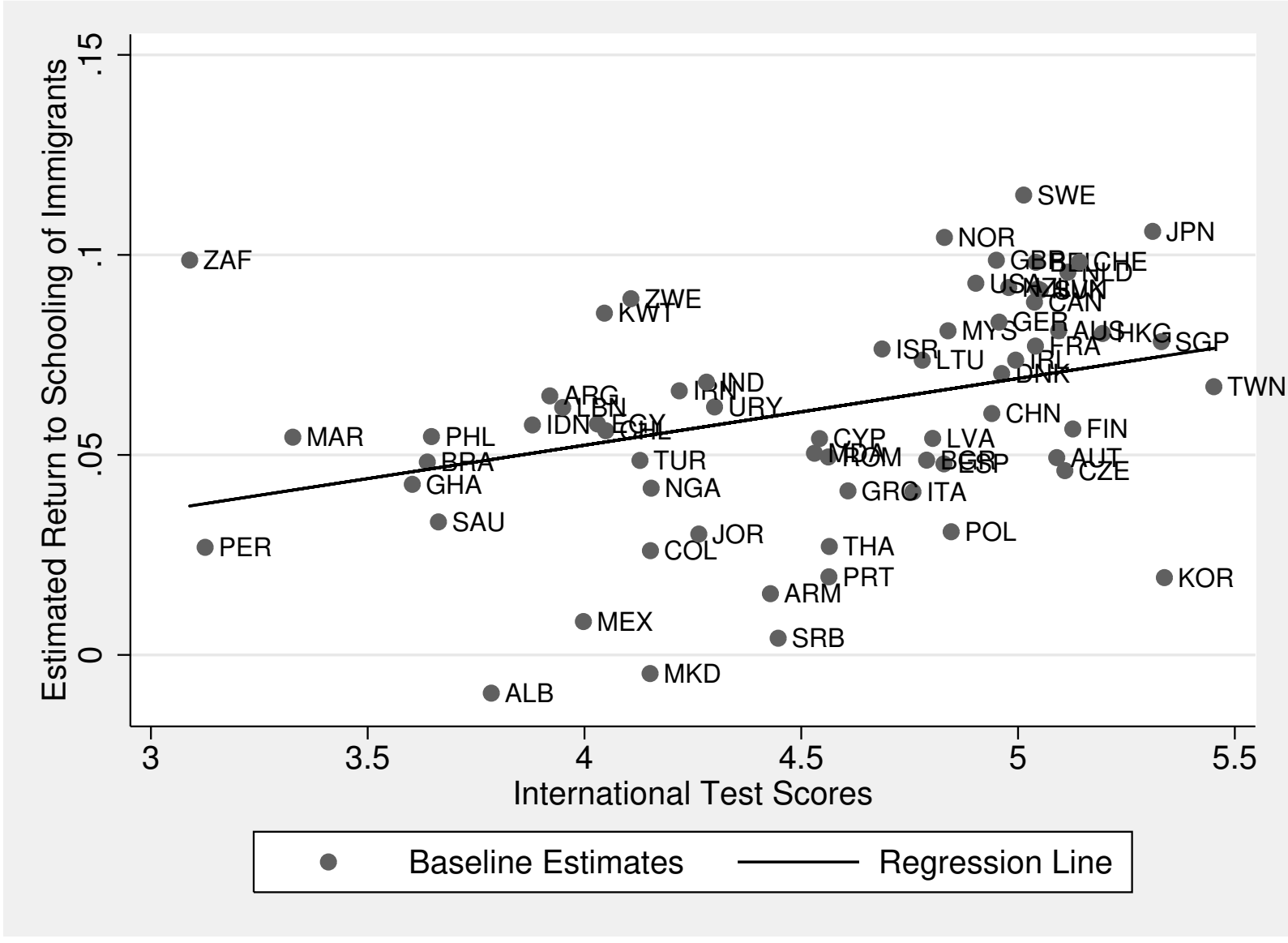
Returns and Test Scores



Interpretation

Basic results robust to controls, sample selection, year. Interpretation:

1. Baseline: education quality
   - Return = human capital generated per year of schooling
   - Development accounting

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Basic results robust to controls, sample selection, year. Interpretation:

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   - Development accounting
2. Alternative: selection
   - Returns would be 9.3% for all countries, but immigrants are selected

Approach to Selection

Twofold approach:

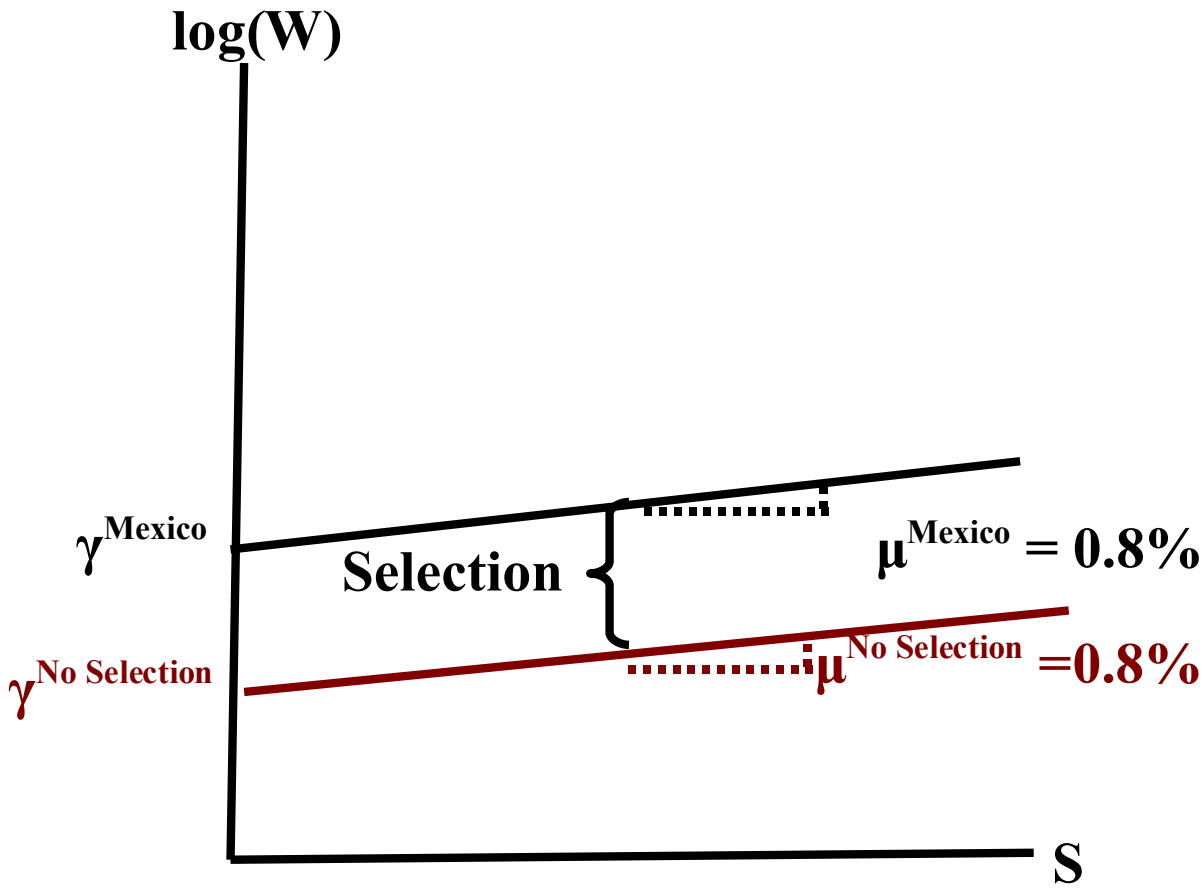
1. Work out type of selection likely to overturn results
2. Use instrumental variables to control for selection (later)

Fixed Effects and Selection

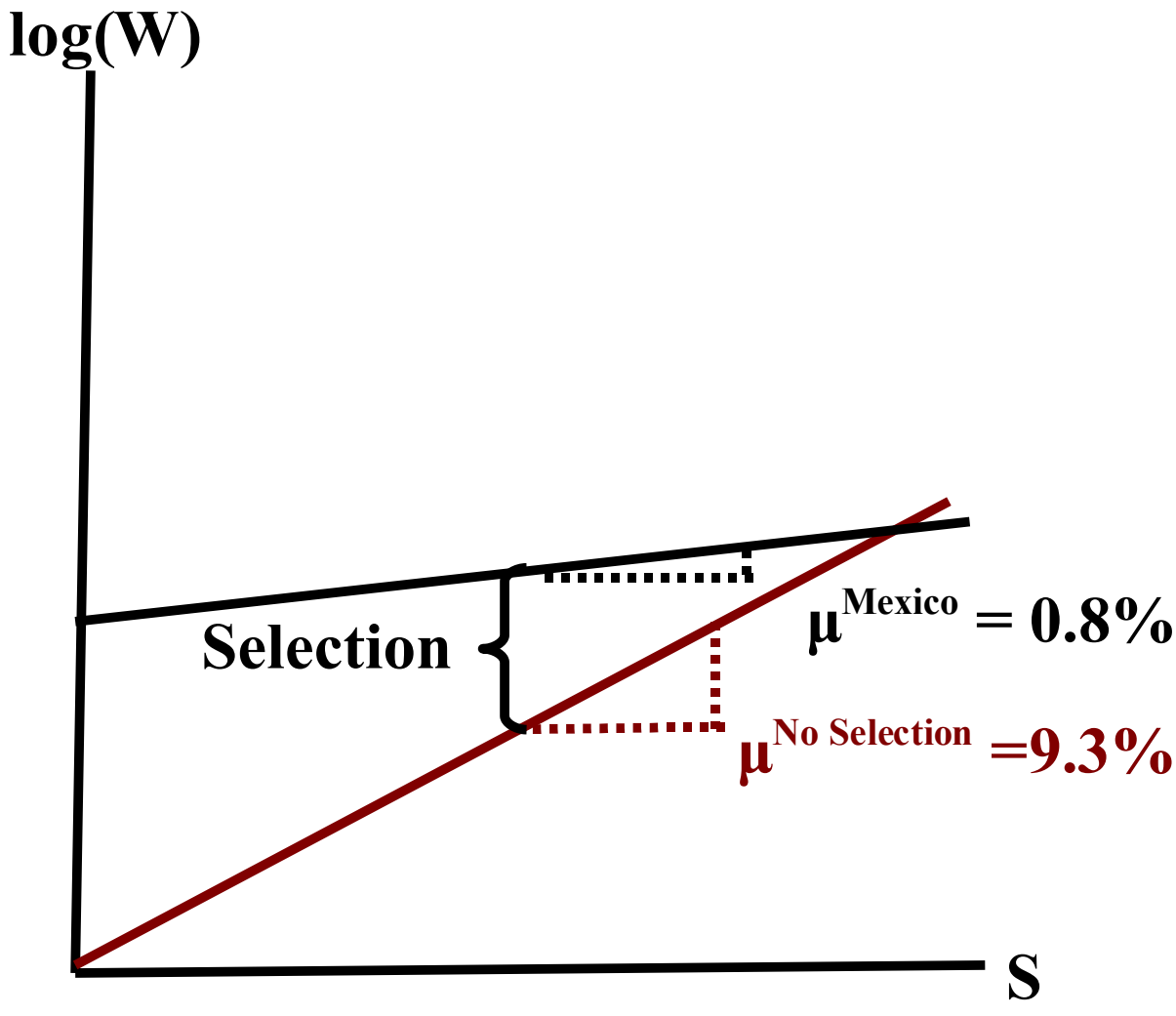
Fixed effects help control for selection.

- If all Mexican immigrants selected by 10%, no effect on returns
- Need differential selection

Simple Selection Does Not Affect Estimation of Returns



Differential Selection Biases Estimation of Returns



Evidence Against Differential Selection

Use evidence from refugees/asylees

- Fleeing religious or political persecution, civil war
- Enter U.S. on humanitarian grounds
- Unlikely to be differentially selected

Study the returns to schooling of refugees and asylees

Evidence Against Differential Selection

Match:

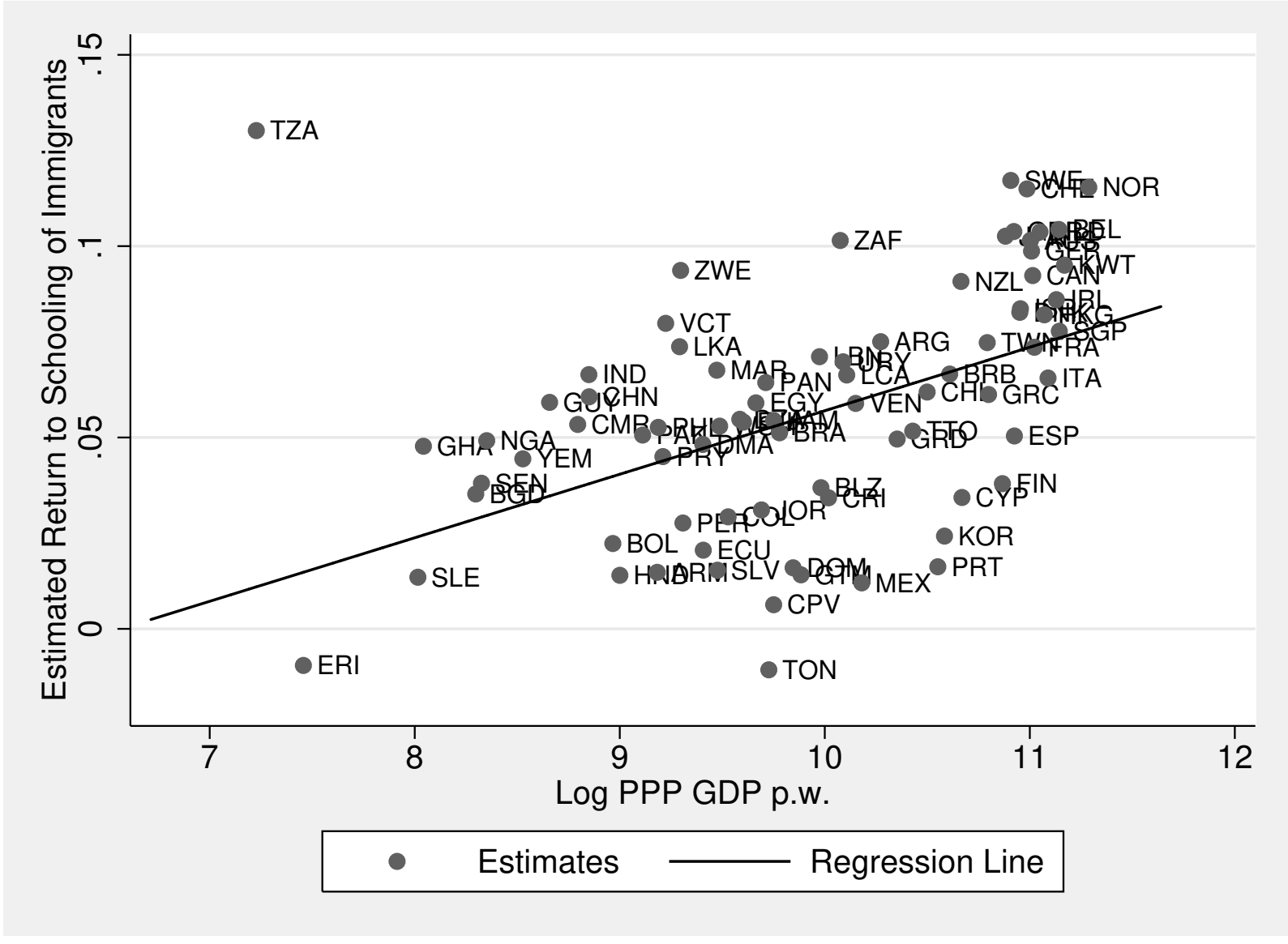
- Census: year of entry, country of birth
- Statistical Yearbook: composition of country's immigrants by year

Two groups of countries:

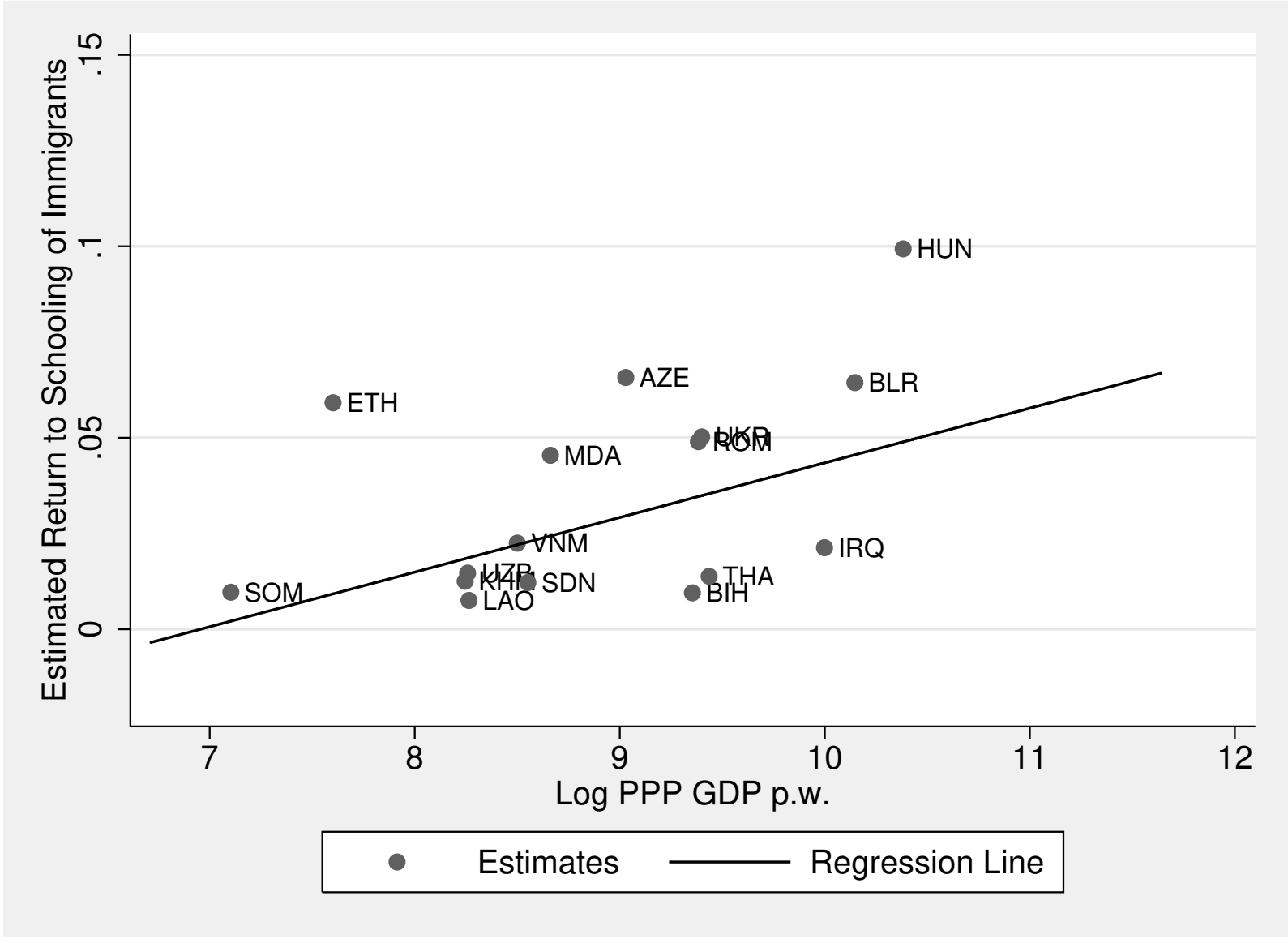
1. 18 countries with $\geq 50\%$ refugees for ≥ 5 years
2. 82 countries with $< 10\%$ refugees for all years

Estimate returns to schooling separately

Economic Migrants



Refugees/Asylees



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Accounting Approach

$$y_j = A_j k_j^{\alpha} \left[h(S_j, Q_j)\right]^{1-\alpha}$$

- Step 1 & 2: $Q_j \approx \mu^j_{US}$
- Step 3: Parameterize $h(S, Q)$
- Step 4: Development accounting

Human Capital Production Function

Propose:

$$h(S, Q) = \exp\left[\frac{(SQ)^{\eta}}{\eta}\right]$$

Properties:

- Extension of **?**
- Quality $\rightarrow$ years of schooling

Identifying η

Human capital production function

$$h(S, Q) = \exp\left[\frac{(SQ)^{\eta}}{\eta}\right]$$

η is unknown

- S and Q are known
- Write down a model of school choice
- Find η so that S_j is consistent with Q_j

Firm's Problem

Representative firm:

- Takes rental rates, wages as given
- Chooses capital and labor input $H = hL$ to maximize profits

Firm's problem:

$$\max_{K,H} AK^{\alpha}H^{1-\alpha} - (r + \delta)K - wH$$

Worker's Problem

Worker's problem similar to Becker (1964)

- Take wages, interest rates, tuition costs, education quality as given
- Choose schooling to maximize income

Worker's problem:

$$\max_S \int_S^T e^{-r_j t} w_j(t) h(S, Q_j) dt - \int_0^S e^{-r_j t} \lambda_j(S, t) dt$$

Assume:

- $w_j(t) = w_j(0) e^{g_j t}$
- $\lambda_j(S, t) = \lambda_j w_j(t) h(S, Q_j)$

Equilibrium School Attainment

Equilibrium attainment for non-migrants:

$$S_j = \left[\frac{Q_j^{\eta}}{M_j}\right]^{1/(1-\eta)}$$

where M_j is the Mincer return for non-migrants

?:

- M_j is weakly correlated with S, y
- $\bar{M} \approx 10\%$

Accounting for Quality-Adjusted Schooling

Substitute for Q_j in h.c. production function:

$$\log(h_j) = \frac{\bar{M}S_j}{\eta}$$

Literature:

$$\log(h_j) = \bar{M}S_j$$

η is quality markup

- $\eta \to 1$: small differences
- $\eta \to 0$: large differences
- Estimate η

Estimating η

Equilibrium attainment:

$$S_j = \left[\frac{Q_j^{\eta}}{M_j}\right]^{1/(1-\eta)}$$

- Estimate $\frac{\eta}{1-\eta}$ from elasticity

Estimating the Elasticity

In logs:

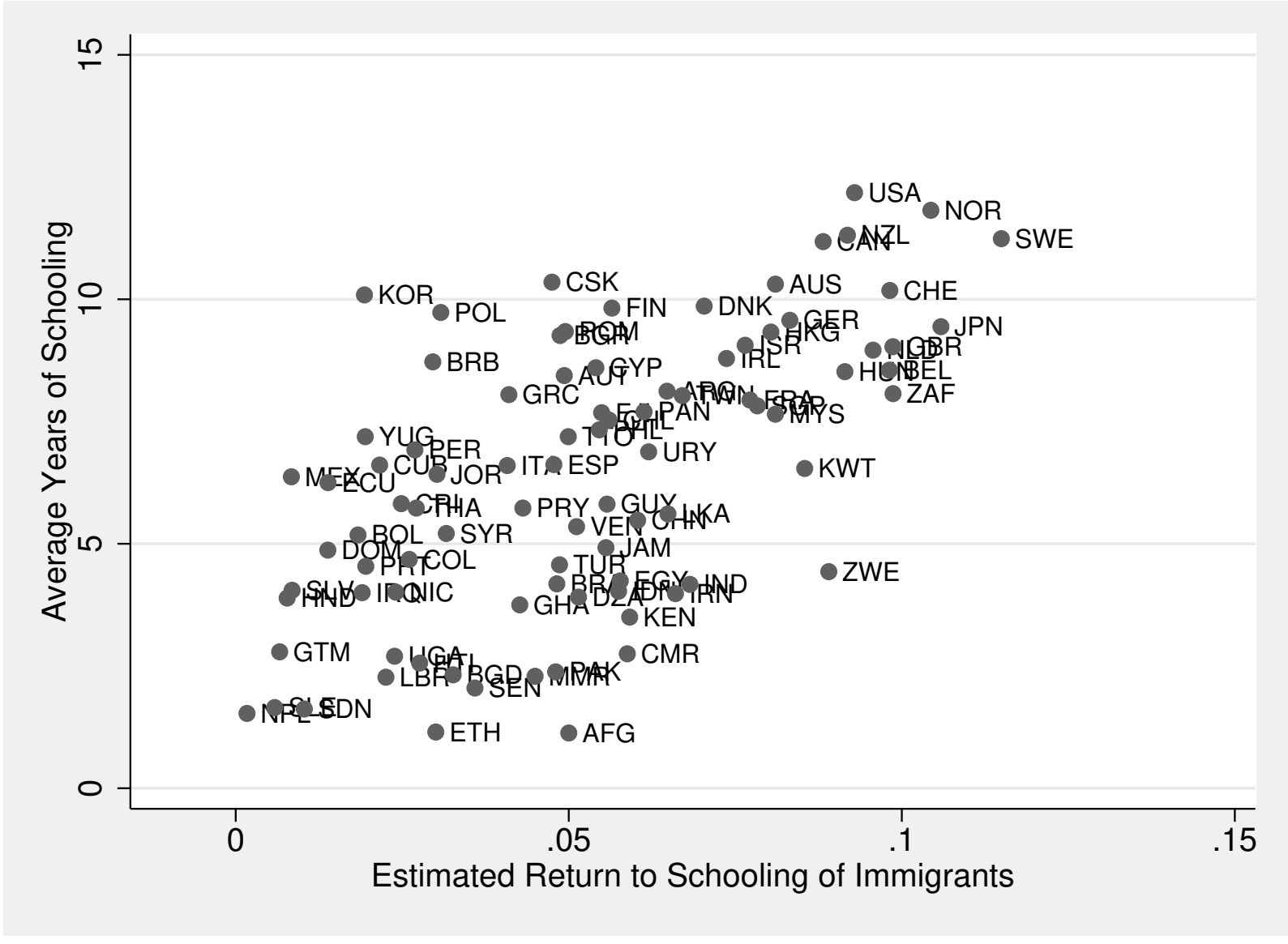
$$\log(S_j) = \frac{\eta}{1-\eta}\log(Q_j) - \frac{1}{1-\eta}\log(M_j)$$

Impose

1. $Q_j = \mu^j_{US}$
2. $M_j = \bar{M}$, enters as constant

$$\log(S_j) = c + \frac{\eta}{1-\eta}\log\left(\mu^j_{US}\right)$$

Estimating the Elasticity



Estimating the Elasticity

Potential concerns using returns to schooling of immigrants

- Noisy
- Residual concerns about selection?

Final step: instrument with test scores

- Correlated
- Exclusion restriction

Estimated Elasticities

	OLS	Baseline Sample, IV			Alt. Samples, IV	
		HW	Weights	HK	1990	Canada
	(1)	(2)	(3)	(5)	(6)	(7)
Elasticity	0.39	1.23	0.70	1.05	1.25	0.72
	(0.066)	(0.562)	(0.331)	(0.295)	(0.94)	(0.570)
Implied η	0.28	0.55	0.42	0.51	0.50	0.42
N	88	51	50	71	41	13

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Baseline Accounting Result

Quality-adjusted schooling:

$$\log(h_j) = \frac{\bar{M}S_j}{\eta}$$

Literature:

$$\log(h_j) = \bar{M}S_j$$

Plausible range for η: $[0.42, 0.55]$

- Quality is 82-138% as important as quantity

Baseline Accounting Results

	$\eta = 0.42$	$\eta = 0.5$	$\eta = 0.55$
h_{90}/h_{10}	6.3	4.7	4.1
$\frac{h_{90}/h_{10}}{y_{90}/y_{10}}$	0.28	0.21	0.18
$\frac{\text{var}[\log(h)]}{\text{var}[\log(y)]}$	0.36	0.26	0.21

Main Results

Results for four steps:

1. Measure returns to schooling of immigrants
   - Returns vary, correlated with output per worker
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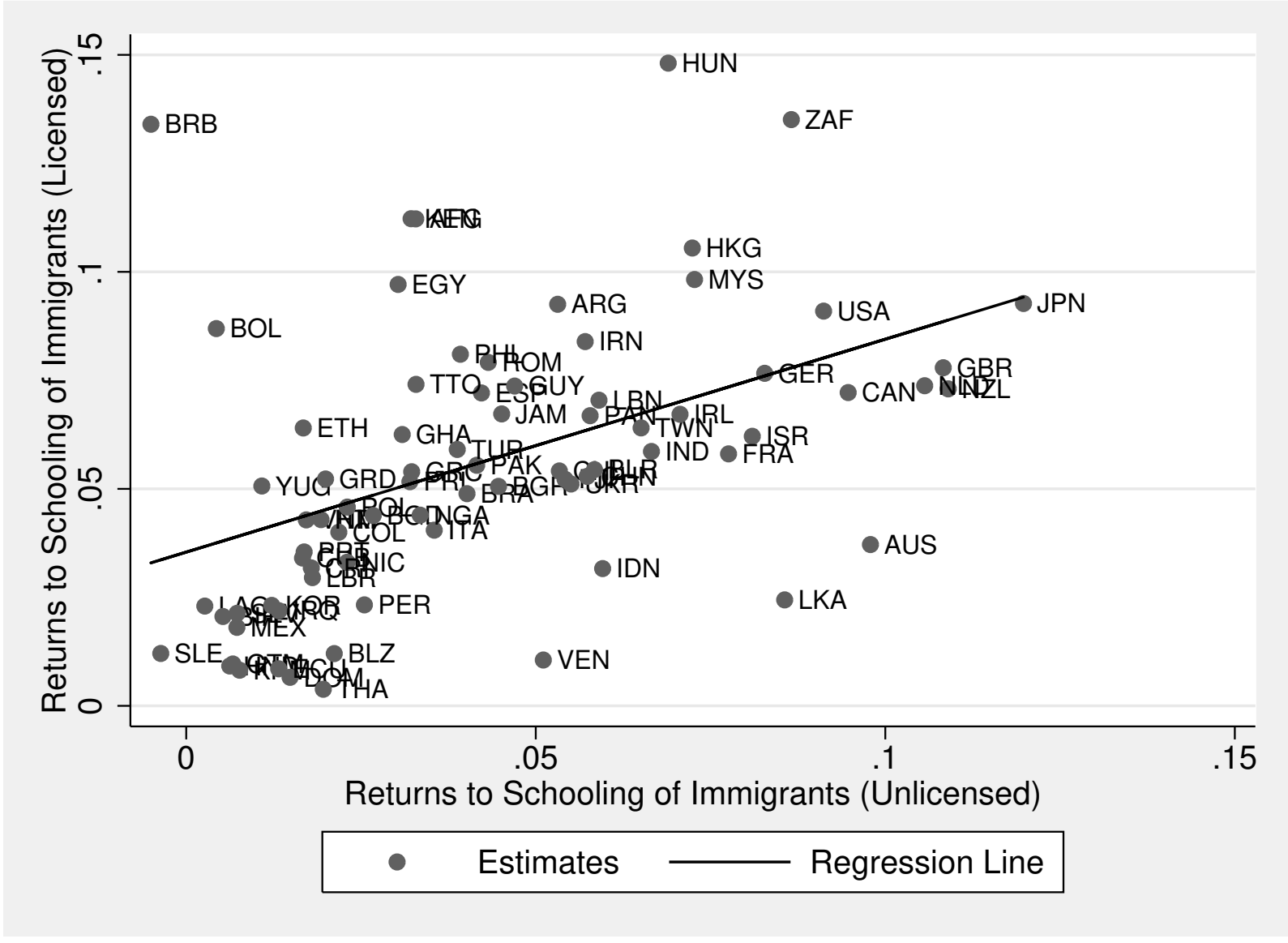
   - Accounts for 20% of y (vs. 10% in literature)

Licensure


Returns to Schooling of Immigrants (Licensed)
0
.05
.1
.15
Returns to Schooling of Immigrants (Unlicensed)
0
.05
.1
.15
HUN
BRB
ZAF
HKG
MYS
EGY
ARG
USA
JPN
BOL
IRN
GER
GBR
TTO
GUY
CAN
JAM
IRL
ETH
GHA
TWN
ISR
IND
FRA
YUG
GRD
PAK
BRA
NGA
COL
ITA
AUS
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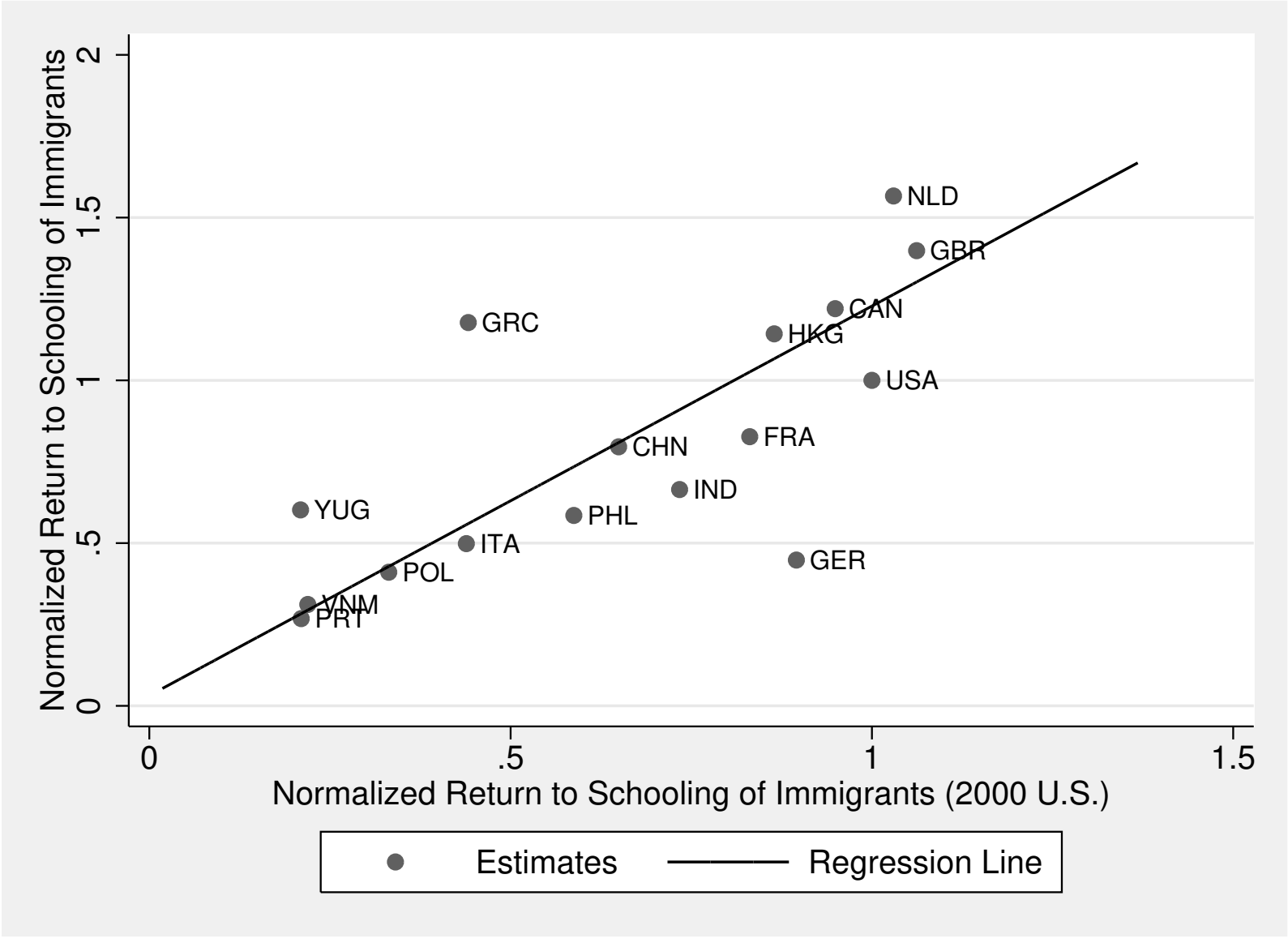
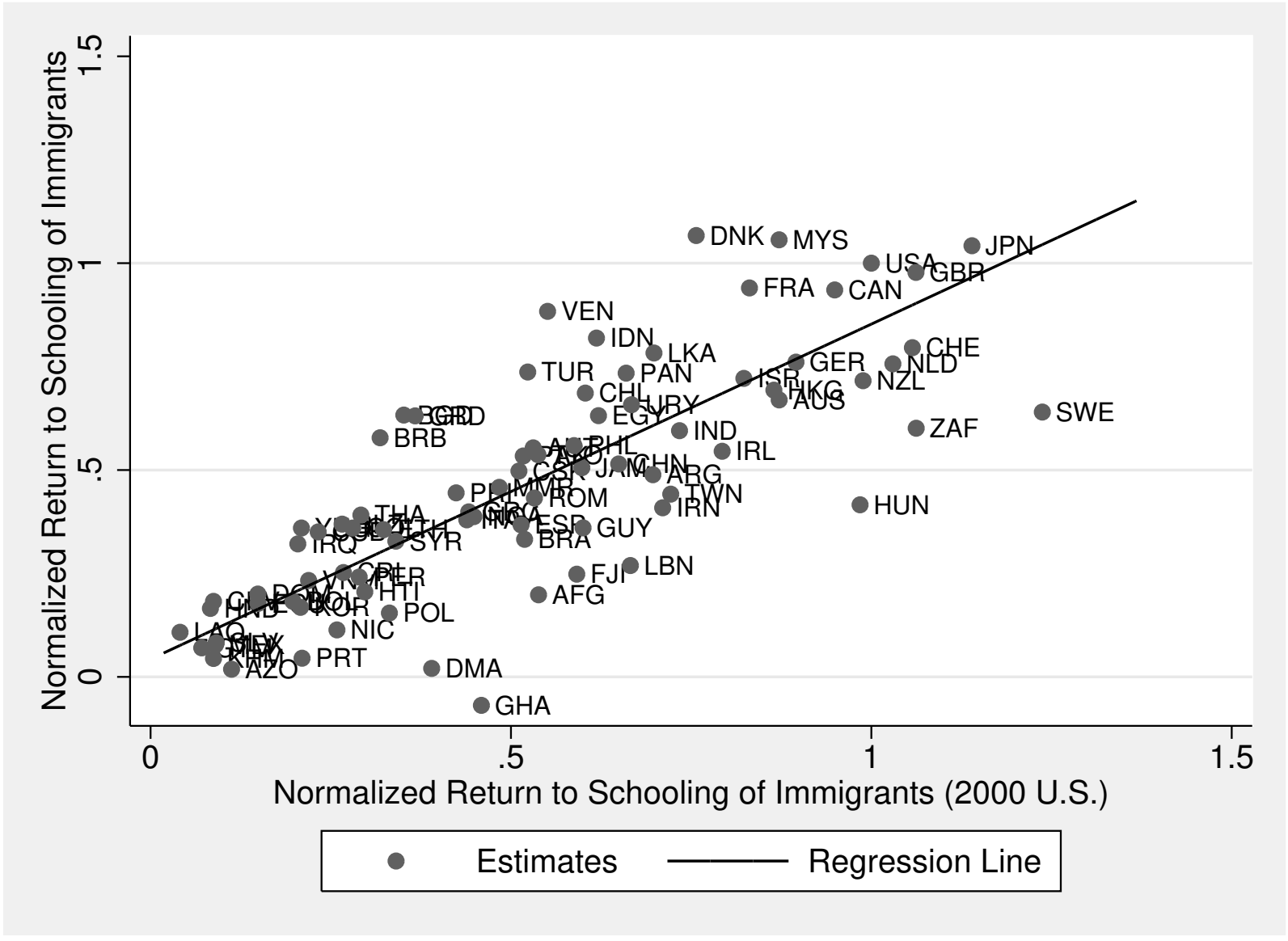
LKA
PER
MEX
SLE
BLZ
VEN
THA
Estimates
Regression Line

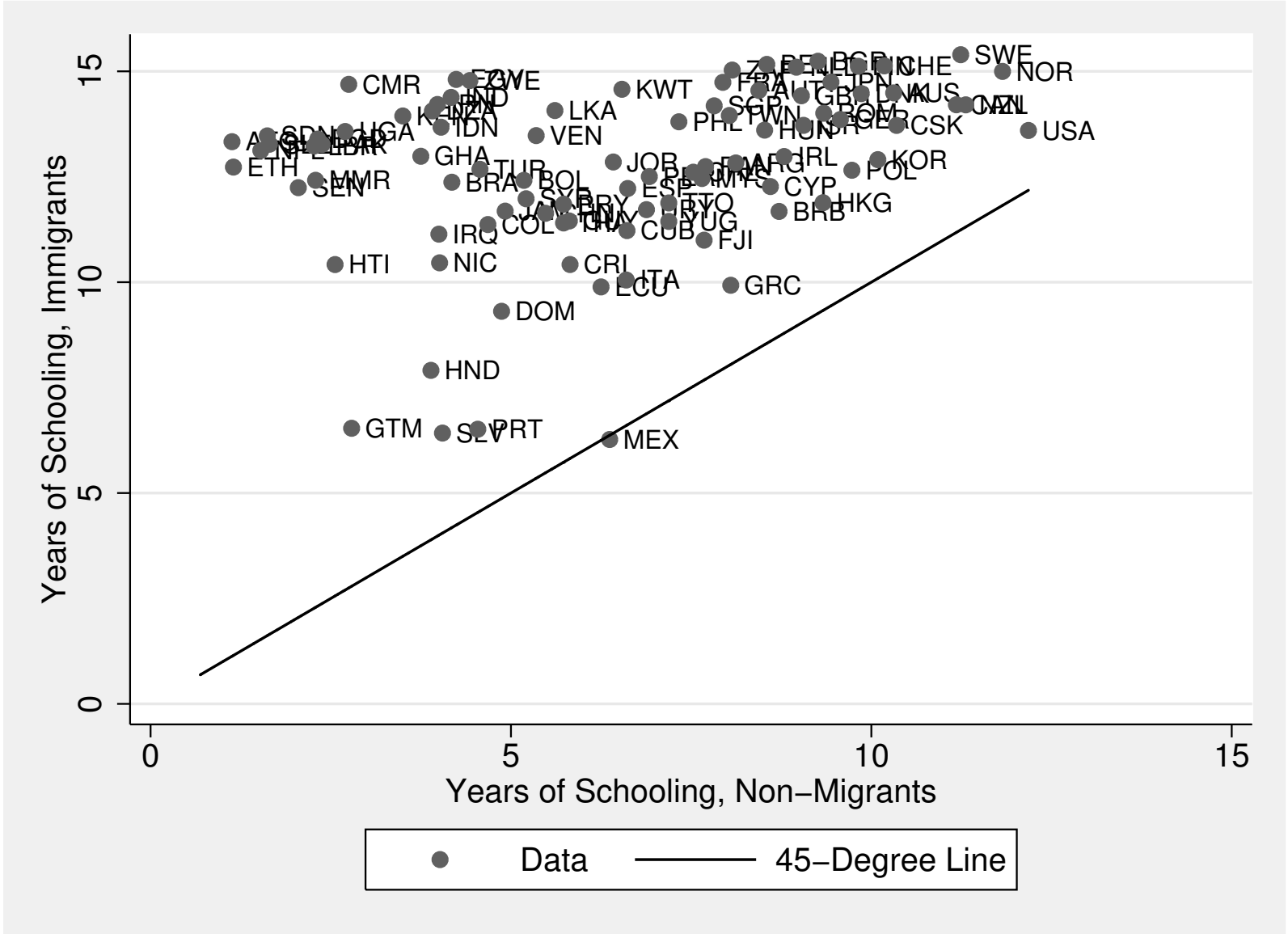
Canada


Normalized Return to Schooling of Immigrants
0
.5
1
1.5
2
NLD
GBR
CAN
GRC
HKG
USA
FRA
CHN
IND
YUG
PHL
ITA
GER
POL
VNM
PRT
0
.5
1
1.5
Normalized Return to Schooling of Immigrants (2000 U.S.)
Estimates
Regression Line

United States, 1990



Years of Schooling, Immigrants and Non-Immigrants



Comparison to Literature, Country by Country