MIT 14.662 Spring 2018: Lecture 2 – The Canonical Model of Skill Differentials

David Autor, MIT and NBER

February 12, 2018

Agenda

1. **Some Motivating Figures**
2. **The Canonical Model**
3. **International Comparisons of Wage Inequality: Supply, Demand and Institutions**

Earnings Differentials between "College" and "High School" Young Adults 30 - 44 in OECD Countries, 2005

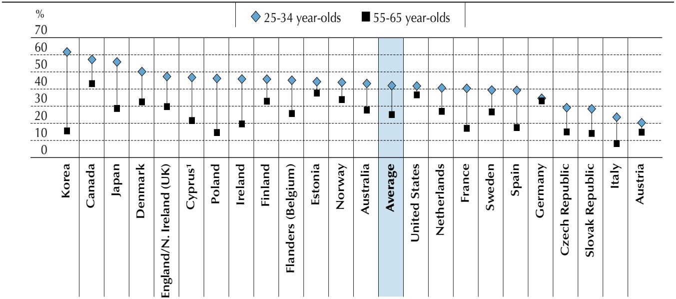
Country	Differential
Denmark	22%
Sweden	22%
Spain	30%
Australia	34%
Belgium	34%
Finland	38%
Italy	43%
Netherlands	47%
Austria	48%
France	48%
Korea	48%
Germany	50%
Ireland	59%
UK	61%

OECD (2007): Education at a Glance

Tertiary Education Completion in OECD Countries as of 2012 by Age Groups, 25 – 34 and 55 – 65

Population with tertiary education

Percentage, by age group



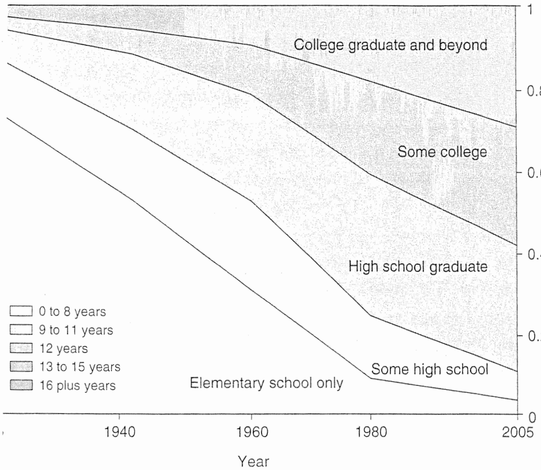
1. See notes at the end of this chapter.

Countries are ranked in descending order of the percentage of 25-34 year-olds with tertiary education.

Source: Survey of Adult Skills (PIAAC) (2012), Table B2.2 in Annex B.

OECD Skills Outlook 2013

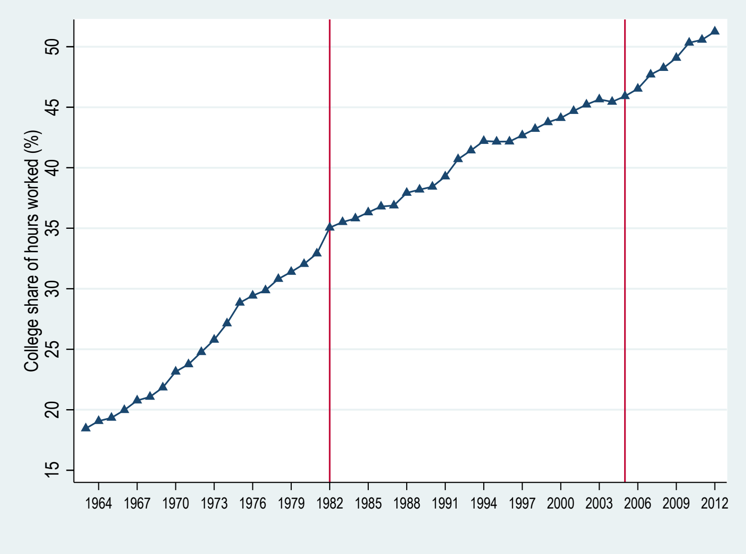
Distribution of Educational Attainment of the U.S. Workforce, 1915 – 2005: So Low in 1915!



1.8. Distribution of Educational Attainment of the Workforce: 1915 to
Sources: See Table 1.2.

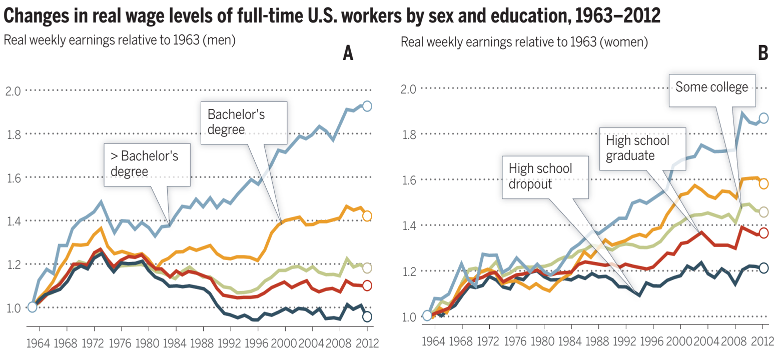
Goldin and Katz 2008

College Share of U.S. Hours Worked, 1963 - 2012



Autor 2014

Indexed Real Full-Time Wages in U.S. by Sex and Education, 1963-2012



Autor, 2014

Agenda

1. Some Motivating Figures
2. **The Canonical Model**
3. International Comparisons of Wage Inequality: Supply, Demand and Institutions

Building blocks

The simplest framework for interpreting skill premia

1. Competitive supply-demand framework
2. Closed economy setting
3. Factors are paid their marginal products
4. Economy operates on its supply and demand curves

This model is a 'workhorse...'

- It's as common as livestock
- Can carry a big load
- Often a bit tired and overburdened

The CES Model: Setup

- Two types of workers, skilled and unskilled (or high and low education, college and non-college, etc.)
- Types are imperfect substitutes. *Why is imperfect substitutability crucial?*
- Suppose that there are $L(t)$ unskilled workers and $H(t)$ skilled workers supplying labor inelastically at time t.
- The production function for the aggregate economy takes the constant elasticity of substitution (CES) form:

$$Y(t) = \left[(A_l(t)L(t))^{\rho} + (A_h(t)H(t))^{\rho}\right]^{1/\rho}$$

  where $\rho \leq 1$ [i.e., $\rho \in (-\infty, 1)$]
- Ignore capital for now and drop time subscripts

The CES Model

- Aggregate production function:

$$Y(t) = \left[(A_l(t)L(t))^{\rho} + (A_h(t)H(t))^{\rho}\right]^{1/\rho}$$

  where $\rho \leq 1$ [i.e., $\rho \in (-\infty, 1)$]

- Elasticity of substitution is given by

$$\sigma \equiv 1/(1-\rho),\ \ \rho \in (-\infty, 1)$$

- Reminder: σ is %Δ in relative demand for low (high) skill workers per %Δ in relative wage of high (low) skill workers.

The CES Model

Aggregate production function

$$Y(t) = \left[(A_l(t)L(t))^\rho + (A_h(t)H(t))^\rho \right]^{1/\rho}$$

Three cases

1. $\sigma \to 0$ (or $\rho \to -\infty$): Skilled and unskilled workers are Leontief. Fixed proportions. 'Perfect complements'
2. $\sigma \to \infty$ (or $\rho \to 1$): Skilled and unskilled workers are perfect substitutes. Changes in aggregate supplies affect the price of skill overall. Relative wage of skilled vs. unskilled (w_H/w_L) is constant.
3. $\sigma \to 1$ (or $\rho \to 0$): Production function is Cobb Douglas, with fixed shares paid to each factor

The CES Model

Aggregate production function

$$Y(t) = \left[(A_l(t)L(t))^{\rho} + (A_h(t)H(t))^{\rho}\right]^{1/\rho}$$

Key distinction

- $\sigma < 1$: Gross complements. A reduction in supply of one input *reduces* demand for the other
- $\sigma > 1$: Gross substitutes. A reduction in supply of one input *raises* demand for the other

A More General Production Function with Skill-Replacing Technologies

$$Y(t) = K^{\alpha}\{(1 - b(t))\,[A_l(t)L(t) + B_l(t)]^{\rho} \\ + b(t)\,[A_h(t)H(t) + B_h(t)]^{\rho}\}^{(1-\alpha)/\rho}$$

- In prior setup, only *factor augmenting* technologies
- Here, B_l, B_h are directly *skill-replacing* technologies
- Intensive versus extensive technical changes
  - b_t a technology that shifts the allocation of tasks among factors
  - A_l, A_h terms are 'intensive' technical changes, augmenting without reallocating
- K is capital: enters in Hicks-neutral form above, no bearing on skill premium
- Note that if $\sigma \to 1$, the $b(t)$ terms limit to the exponents in the Cobb-Douglas production function

The CES Model

Three interpretations of this aggregate model

1. Only one good, skilled and unskilled workers are imperfect substitutes in its production
2. Two-good economy:
   - Consumers have utility function $[Y_l^\rho + Y_h^\rho]^{1/\rho}$ with elasticity of substitution $\sigma = 1/(1-\rho)$
   - Good Y_h is produced with $Y_h = A_h H$
   - Good Y_l is produced with $Y_l = A_l L$
3. A mixture of these two where different sectors produce goods that are imperfect substitutes, and high and low education workers are employed in all sectors

Wage Setting

Given competitive labor markets, wages are set according to marginal products

$$w_L = \frac{\partial Y}{\partial L} = A_l^{\rho}[A_l^{\rho} + A_h^{\rho}(H/L)^{\rho}]^{(1-\rho)/\rho}$$

and

$$w_H = \frac{\partial Y}{\partial H} = A_h^{\rho}[A_h^{\rho} + A_l^{\rho}(H/L)^{-\rho}]^{(1-\rho)/\rho}$$

Two immediate results

1. First $\partial w_H/\partial(H/L) < 0$. Why?
2. Second $\partial w_L/\partial(H/L) > 0$. Why?

The CES Model

Combining the wage equations to get skill premium π

$$\pi = \frac{w_H}{w_L} = \left(\frac{A_h}{A_l}\right)^{\rho} \left(\frac{H}{L}\right)^{-(1-\rho)} = \left(\frac{A_h}{A_l}\right)^{(\sigma-1)/\sigma} \left(\frac{H}{L}\right)^{-1/\sigma}$$

Taking logs

$$\ln \pi = \left(\frac{\sigma - 1}{\sigma}\right) \ln \left(\frac{A_h}{A_l}\right) - \frac{1}{\sigma} \ln \left(\frac{H}{L}\right)$$

Notice that

$$\frac{\partial \ln \pi}{\partial \ln(H/L)} = -\frac{1}{\sigma} < 0$$

- *Relative* demand curve for H vs. L is downward sloping (recall that $\sigma \geq 0$)
- For given 'skill bias,' A_h/A_l, an increase in relative supplies H/L lowers relative wages with elasticity σ (*except when?*)

The CES Model

Seriously, WTF is σ?

- Aggregate production function is an abstraction
- *Not* intended to correspond to production function of any given firm
- Combines substitution in production and consumption across consumers, industries, firms, plants within firms, etc
- Would expect factors to be less substitutable at the firm level than at the aggregate level

Where to aggregate production functions come from?

- See Jones 2005 *QJE*, Houthakker 1955 *ReStud*

What are plausible values of σ?

- Surprising degree of consensus: $\sigma \in [1, 2]$

Technical change and the skill premium

How does the skill premium respond to a shift in A_h/A_l?

- Differentiating

$$\ln \pi = \left(\frac{\sigma - 1}{\sigma}\right) \ln \left(\frac{A_h}{A_l}\right) - \frac{1}{\sigma} \ln \left(\frac{H}{L}\right)$$

  yields

$$\frac{\partial \ln \omega}{\partial \ln(A_h/A_l)} = \frac{\sigma - 1}{\sigma},$$

- *Why would an increase in the productivity of more skilled workers, that is a rise in A_h/A_l, cause their wages to fall?*

Summary of key relationships: Skill supplies

An exogenous rise in H/L

1. The skill premium $\pi = W_H/W_L$ falls
2. Wages of unskilled workers rise
3. Wages of skilled workers decrease
4. Average wages rise provided the skill premium is positive

$$\overline{w} = \frac{LW_L + HW_H}{L + H} = \frac{[(A_l)^\rho + (A_h H/L)^\rho]^{1/\rho}}{1 + H/L},$$

Increasing in H/L provided the skill premium is positive ($\pi > 0$ or $A_h^\rho (H/L)^\rho - A_l^\rho > 0$)

Summary of key relationships: Factor-biased technical change

An increase in A_h, holding A_l and L/H constant

1. $\omega = W_H/W_L$ rises if $\sigma > 1$, falls if $\sigma < 1$, and is unchanged if $\sigma = 1$
2. Average wages rise if $\sigma > 0$. Why not if $\sigma = 0$?
3. Wages of L workers rise if $\sigma < \infty$. Why not if $\sigma = \infty$?
4. Both W_H and W_L rise if $\sigma \geq 1$. Why not if $\sigma < 1$?

General takeaway: It's hard for factor-augmenting technical change to lower wages (though of course π may rise)

The long term skill bias of technical change

Key implication: As H/L increases, the skill premium (π) falls

- In every advanced country the supply of educated workers has risen dramatically in the past seven decades
- Yet relative wages of better educated workers have remained consistently above those of less educated
- U.S. college-educated share rose from 6.4 to 29.7 percent from 1940 to 2000. High school dropout share fell from 68 to 9 percent of the workforce
- Yet, the skill premium in 2000 (measured in a variety of ways) was at or above that of in 1940 (though not above that in 1915

If we believe this model at all, suggests that relative demand for skilled workers *must* have risen practically everywhere

Tinbergen: Education race

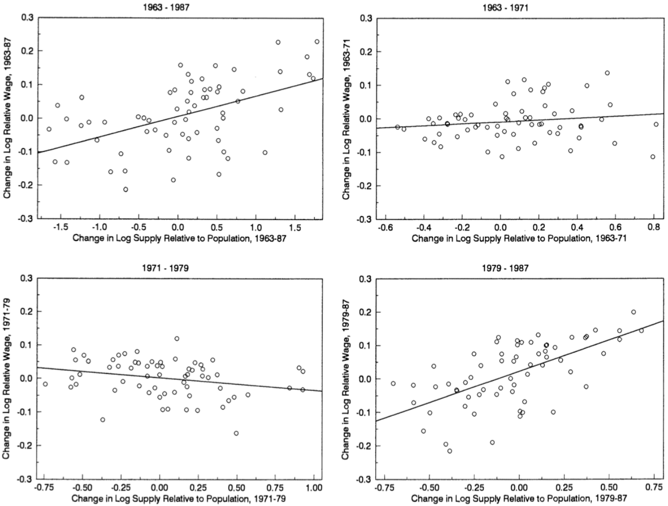
Jan Tinbergen, 1975

> *"The two preponderant forces at work are technological development, which made for a relative increase in demand and hence in the income ratio... and increased access to schooling, which made for a relative decrease."*

Translation

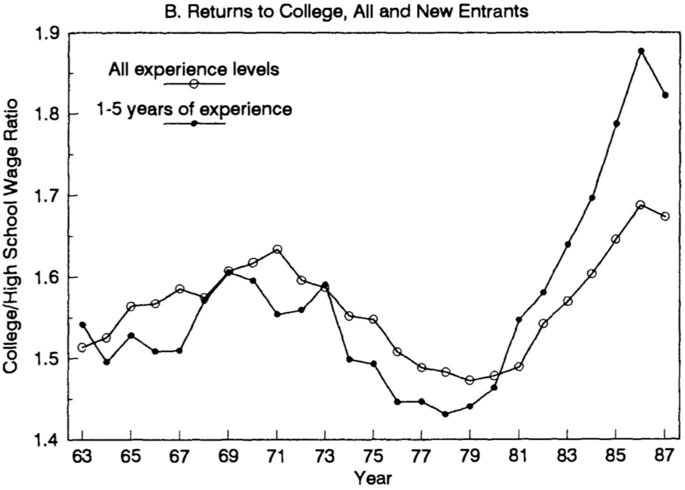
- Long term trend increases towards greater relative demand *and* greater supply of skilled workers
- Bursts of supply and/or technologically-induced demand accelerations/decelerations that cause demand to temporarily move out more rapidly than supply or vice versa in some eras.

Wages by Skill Group: 1963-1987 (Katz-Murphy 1992)



Katz and Murphy 1992

Katz-Murphy '92: Evolution of College Premium



Katz and Murphy 1992

Bringing the model to the data

Relative productivity of skilled workers

$$\ln \pi = \ln W_h / W_l = \left(\frac{\sigma - 1}{\sigma} \right) \ln \left(\frac{A_h}{A_l} \right) - \frac{1}{\sigma} \ln \left(\frac{H}{L} \right)$$

- The technological parameter is $\frac{\sigma-1}{\sigma} \ln (A_h / A_l)$ or simply $(\sigma - 1) \ln (A_h / A_l)$ since denominator just a scalar
- Must have increased considerably since 1939 (i.e., first representative data on skill supplies and wages)

How much has $(\sigma - 1) \ln (A_h / A_l)$ increased?

- We can observe H/L and $\pi = \ln W_h / W_l$
- If we knew σ, could infer $\Delta \ln (A_h / A_l)$
- This approach pioneered by Katz and Murphy 1992

If we wanted to estimate this model with time-series data

'Structural' equation

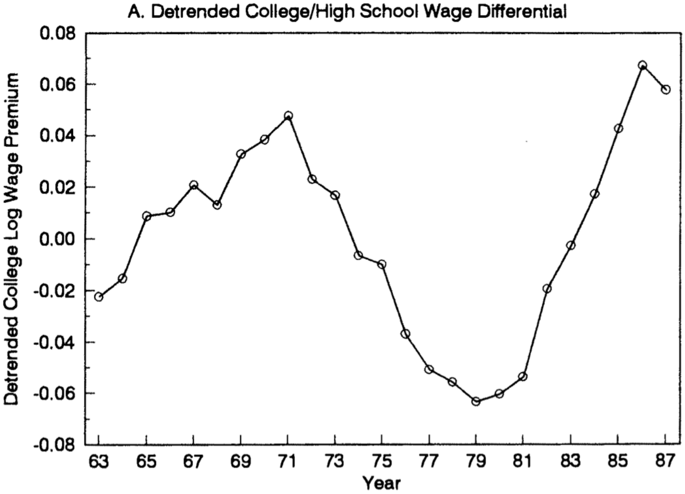
$$\ln \pi = \frac{\sigma - 1}{\sigma} \ln \left(\frac{A_h}{A_l} \right) - \frac{1}{\sigma} \ln \left(\frac{H}{L} \right)$$

- Add time subscripts to everything except for σ

$$\ln \pi_t = \gamma_0 + \gamma_1 t + \gamma_2 \ln(H/L)_t + e_t.$$

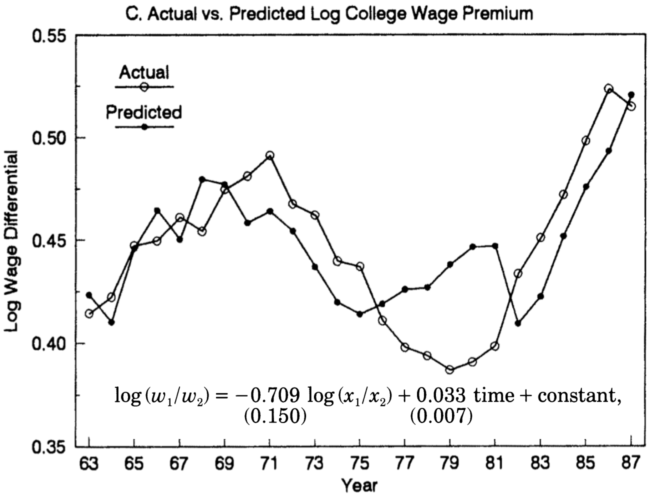
- We observe $(H/L)_t$ and π_t
- Unknowns are σ and $(A_h/A_L)_t$
- γ_o is a constant, γ_1 gives the time trend on $(\frac{\sigma-1}{\sigma}) \ln(A_{ht}/A_{Lt})$, and $\hat{\gamma}_2$ is an estimate of $1/\sigma$
- Identification assumptions: (1) $\ln(H/L)_t$ is exogenous or quasi-fixed; (2) $\partial \ln(A_h/A_L)/\partial t$ is approximately linear

Data to be Explained: Katz-Murphy 1992



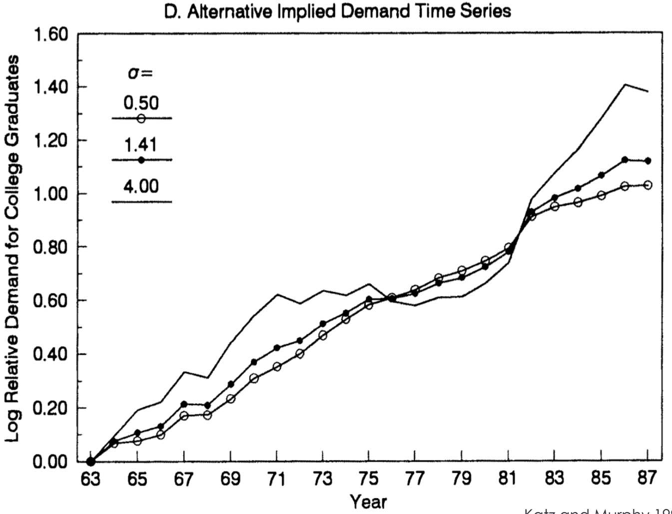
Katz and Murphy 1992

Model Fit: $\hat{\sigma} = -(1/0.71) = 1.41$ [$R^2 = 0.52$]



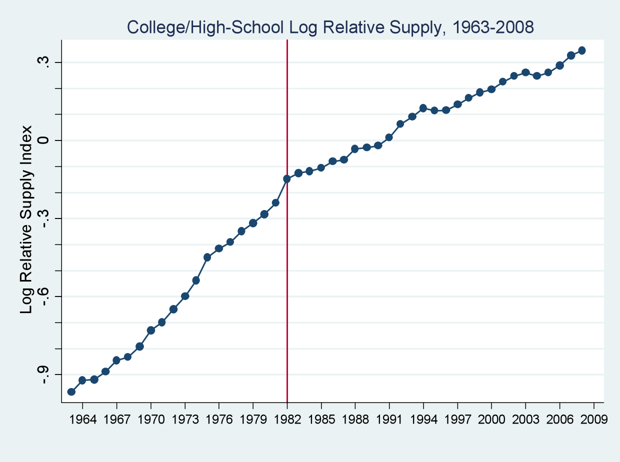
Katz and Murphy 1992

Implied Demand Series: Alternative Values of σ



Katz and Murphy 1992

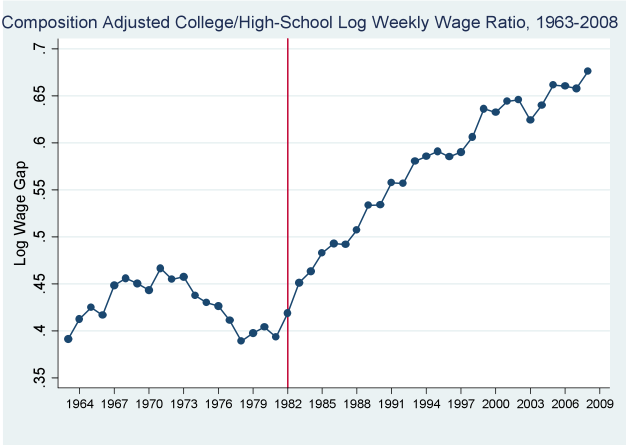
Acemoglu-Autor Replication/Update: Supply Series



Source: March CPS data for earnings years 1963-2008. Labor supply is calculated using all persons ages 16-64 who reported having worked at least one week in the earnings years, excluding those in the military. The data are sorted into

Acemoglu-Autor 2011

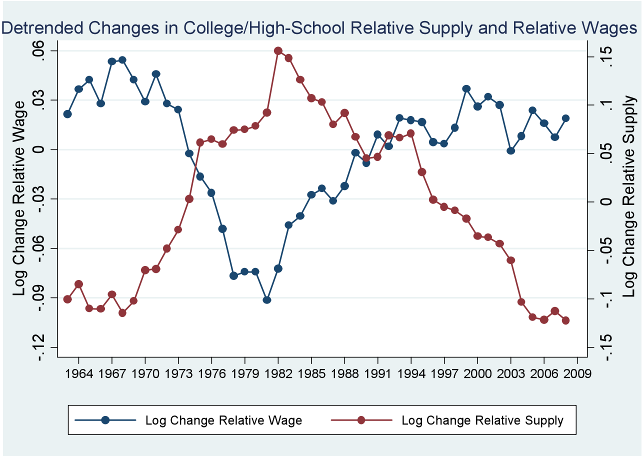
Acemoglu-Autor Replication/Update to 2008



Source: March CPS data for earnings years 1963-2008. Log weekly wages for full-time, full-year workers are regressed in each year on four education dummies (high school dropout, some college, college graduate, greater than college), a quartic in experience, interactions of the education dummies and experience quartic, and two race categories (black,

Acemoglu-Autor 2011

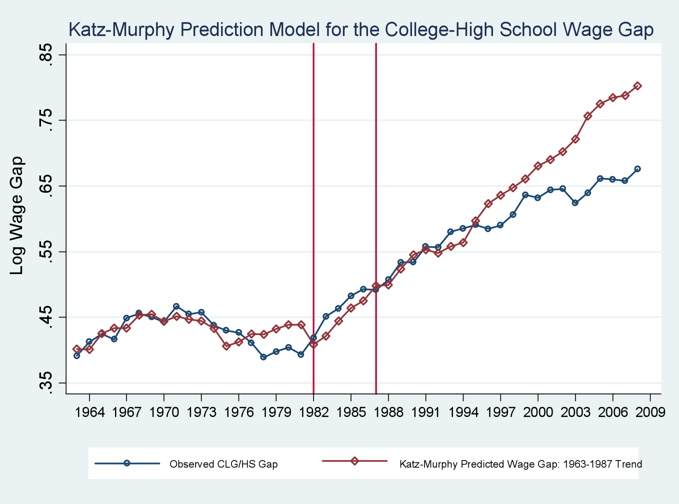
Detrended Supply and Demand Series: 1963-2008



Source: March CPS data for earnings years 1963-2008. See note to Figure 21. The detrended supply and wage series are the residuals from separate OLS regressions of the relative supply and relative wage measures on a constant and a linear time trend.

Acemoglu-Autor 2011

KM Model Fit 1963-1987, Out of Sample 1987-2008



Acemoglu-Autor 2011

KM Model Fit: Regression Version, 1987-2008

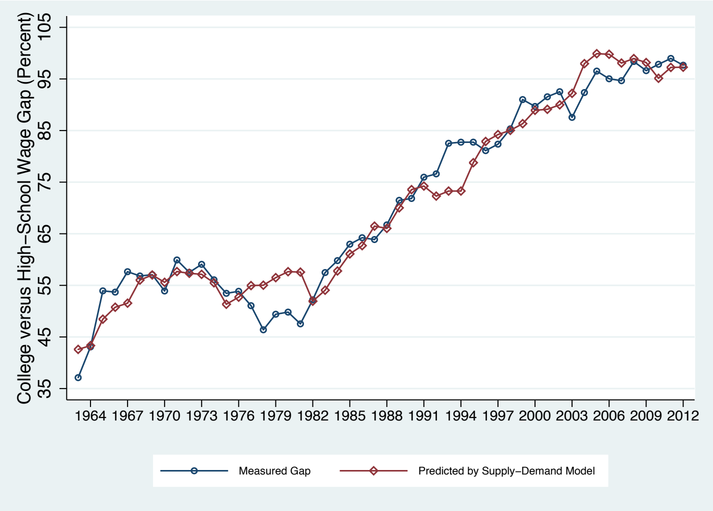
Table 8 Regression models for the college/high school log wage gap, 1963-2008.

	1963-1987		1963-2008		
	(1)	(2)	(3)	(4)	(5)
CLG/HS relative supply	−0.612 (0.128)	−0.339 (0.043)	−0.644 (0.066)	−0.562 (0.112)	−0.556 (0.094)
Time	0.027 (0.005)	0.016 (0.001)	0.028 (0.002)	0.029 (0.006)	0.020 (0.006)
Time X post-1992			−0.010 (0.002)		
$Time^2/100$				−0.013 (0.006)	0.036 (0.012)
$Time^3/1000$					−0.007 (0.002)
Constant	−0.217 (0.134)	0.059 (0.039)	−0.254 (0.066)	−0.189 (0.122)	−0.145 (0.103)
Observations	25	46	46	46	46
R-squared	0.558	0.935	0.961	0.941	0.960

Source: March CPS data for earnings years 1963-2008. See notes to Figs 2 and 19.

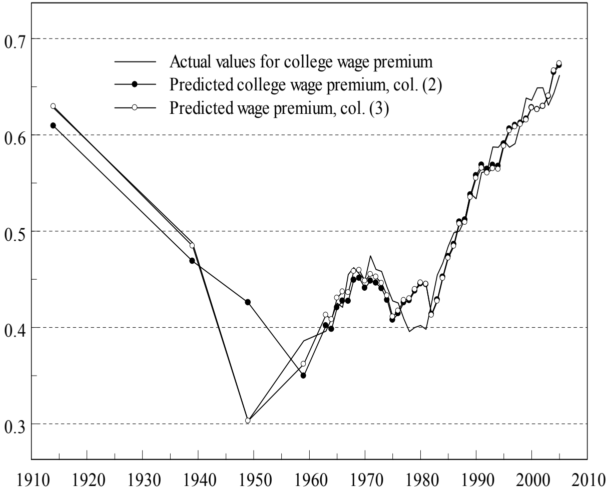
Acemoglu-Autor 2011

KM Fit: 1963 – 2012 in Sample, using Quadratic Cheat



Autor 2014

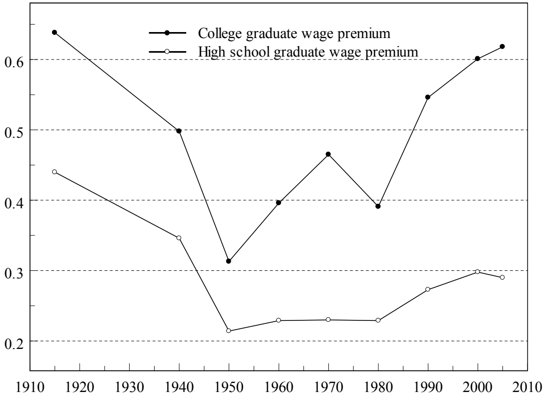
The U.S. Return to Education in the Longer Run 1915 – 2005



Goldin and Katz, 2007

The U.S. College/High-School and High-School/Dropout Wage Premiums over the Long Run 1915 – 2005

Figure 1
College Graduate and High School Graduate Wage Premiums: 1915 to 2005



Goldin and Katz 2008

Models for the High-School/Dropout Wage Premium, 1915 - 2005

Table 4
Determinants of the High School Wage Premium: 1915 to 2005

	(1)	(2)	(3)	(4)	(5)
(High school/dropout) supply	-0.180 (0.059)	-0.193 (0.039)	-0.193 (0.039)	-0.512 (0.071)	-0.352 (0.137)
(High school/dropout) supply × post-1949				0.322 (0.054)	
(High school/dropout) supply × time					0.00496 (0.00218)
Time	-0.00084 (0.00278)	0.00239 (0.00179)	0.00235 (0.00176)	0.0171 (0.0037)	0.0308 (0.0100)
Time × post-1949	0.0132 (0.0011)			-0.0032 (0.0029)	
Time × post-1959		0.0117 (0.0006)	0.0116 (0.0006)		
Time × post-1992	-0.00753 (0.00386)	-0.0109 (0.0026)	-0.0107 (0.0026)	-0.0106 (0.0029)	
1949 Dummy			-0.0278 (0.0192)		
$Time^2 \times 10$					-0.0084 (0.0012)
$Time^3 \times 1000$					0.113 (0.025)
$Time^4 \times 10,000$					-0.0055 (0.0015)
Constant	0.088 (0.118)	0.049 (0.078)	0.053 (0.077)	-0.579 (0.142)	-0.282 (0.271)
R^2	0.897	0.953	0.956	0.944	0.971
Number of observations	47	47	47	47	47

Krussell, Ohanian, Rios-Rull, and Violante, 2000: Declining Log Relative Price of Equipment Capital, 1963 – 1992

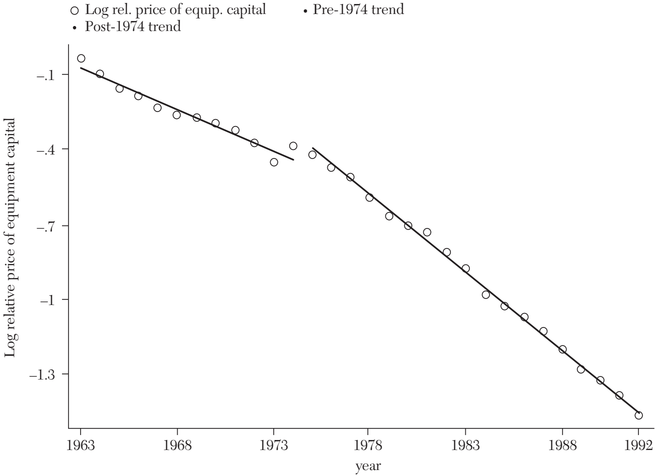


Figure 6. Behavior of the Log Relative Price of Equipment Capital, 1963–92

Krussell, Ohanian, Rios-Rull and Violante, 2000 (reprinted in Acemoglu 2002)

KORRV 2000: An Alternative Explanation, Declining Log Relative Price of Equipment Capital, 1963 – 1992

$$G\left(k_{st}, k_{et}, L_t, H_t\right) = k_{st}^{\alpha}\left[\beta L_t^{\delta} + (1-\beta)\left(\lambda k_{et}^{\rho} + (1-\lambda) H_t^{\rho}\right)^{\delta/\rho}\right]^{(1-\alpha)/\delta}$$

- k_{st} is structures capital, k_{et} is equipment capital
- α is structure share of output (note: Cobb-Douglas)
- β is the extensive margin technological parameter
- $\sigma_e = 1/\left(1-\rho\right)$ is elasticity btwn H labor and equipment capital k_e
- $\sigma_u = 1/\left(1-\delta\right)$ is elasticity btwn $H + K_e$ aggregate and L

Key condition: $\sigma_u > \sigma_e$

- If elasticity btwn $H + K_e$ vs. L greater than elasticity btwn K_e and H, then K_e is a *relative* complement to H.
- $\sigma_u > \sigma_e$ implies **equipment-skill complementarity**

Estimation of K-S Complementarity Model (KORRV 2000)

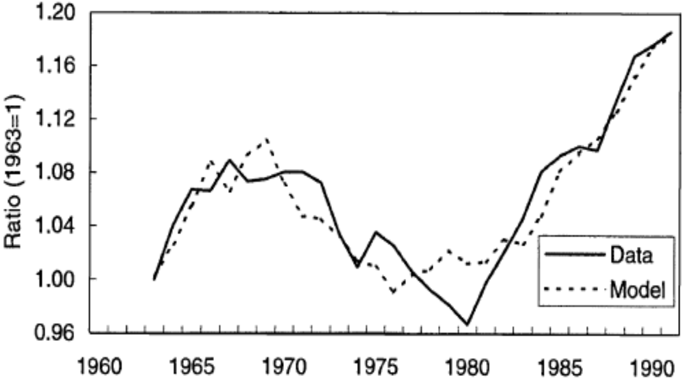
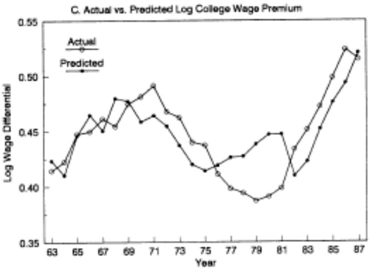


Figure 8. The skill premium: Skilled vs. unskilled wages per hour (normalized with 1963=1).

Krussell, Ohanian, Rios-Rull and Violante, 2000

Does this Chart Look Familiar?



Katz and Murphy 1992

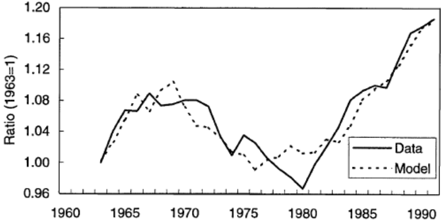


Figure 8. The skill premium: Skilled vs. unskilled wages per hour (normalized with 1963=1).

Krussell, Ohanian, Rios-Rull and Violante, 2000

Equipment Prices – or Time Trend?

TABLE 2
THE EFFECT OF THE RELATIVE PRICE OF EQUIPMENT ON SKILLED PREMIA

Dependent variable is log college premium

	(1)	(2)	(3)	(4)	(5)
Relative supply	–0.742 (0.053)	–0.388 (0.037)	–0.610 (0.068)	–0.691 (0.100)	–0.740 (0.054)
Time	0.026 (0.002)			0.022 (0.007)	0.024 (0.005)
Log relative price		–0.323 (0.024)		–0.051 (0.084)	
Relative price			–0.875 (0.086)		–0.056 (0.167)
Adjusted R^2	0.900	0.864	0.795	0.898	0.897

Note: This table reports the regression of the log college premium on a linear time trend, the log relative supply of skilled workers and various measures of the relative price of equipment capital. For comparability, all data taken from Krusell et al. (2000).

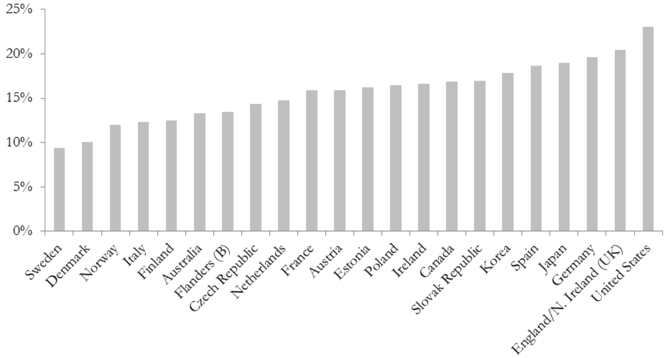
Acemoglu 2002

Agenda

1. Some Motivating Figures
2. The Canonical Model
3. **International Comparisons of Wage Inequality: Supply, Demand and Institutions**

Cross-National Differences in Estimated Wage Returns to PIACC (2012) Skills

Figure 2. The return to skill, United States and other PIAAC countries



Notes: The figure shows the coefficient on skill from a regression of log hourly wages (including bonuses) for wage and salary earners (in PPP corrected USD) on standardized numeracy scores and a quartic of experience.

Broecke, Quintini and Vandeweyer 2016

Abstract: Blau and Kahn, JPE 1996

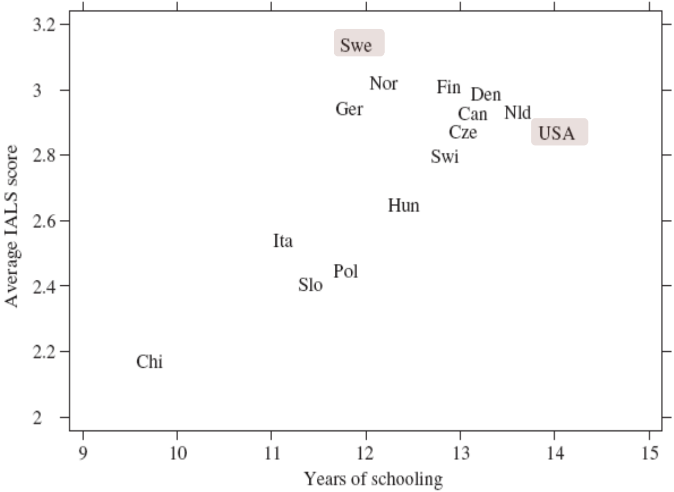
International Differences in Male Wage Inequality: Institutions versus Market Forces

Francine D. Blau
Cornell University and National Bureau of Economic Research

Lawrence M. Kahn
Cornell University

This paper studies the considerably higher level of wage inequality in the United States than in nine other OECD countries. We find that the greater overall U.S. wage dispersion primarily reflects substantially more compression at the bottom of the wage distribution in the other countries. While differences in the distribution of measured characteristics help to explain some aspects of the international differences, higher U.S. prices (i.e., rewards to skills and rents) are an important factor. Labor market institutions, chiefly the relatively decentralized wage-setting mechanisms in the United States, provide the most persuasive explanation for these patterns.

Does More School Equal More Skill?



Leuven, Oosterbeek and van Ophem 2004

Fig. 1. *Cross Sectional Relation Between Years of Schooling and Skill*

IALS data used by Leuven, Oosterbeek and van Ophem

- *Prose literacy* – the knowledge and skills needed to understand and use information from texts including editorials, news stories, poems and fiction,
- *Document literacy* – the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and graphics; and
- *Quantitative literacy or numeracy* – the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials, such as balancing a checkbook, figuring out a tip, completing an order form or determining the interest on a loan from an advertisement.

A Cross-National Supply Demand Analysis: Supply Index

Constructing a skill supply measure: s_{kj}

- Choose a baseline country b, and group workers in *all* countries into three skill groups $k = \{\text{low, medium, high}\}$
- Use as cut-points the values in country b that break the skill distribution (proxied by IALS scores) into three even parts
- For each country $j \neq b$, LOvO form a relative skill *supply index* of:

$$s_{kj} = \ln\left(E_{kj}/E_{kb}\right)$$

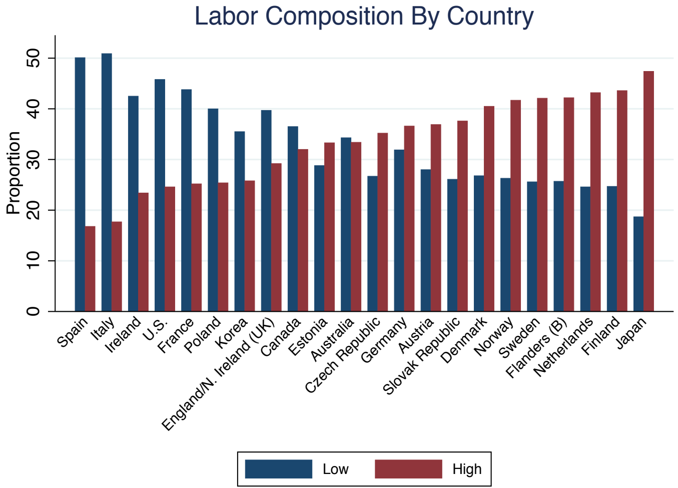
where E_{kj}, E_{kb} are the shares of total labor input supplied by skill group k in countries j and b respectively (the latter being equal to $\frac{1}{3}$ by construction)

Skill Tercile Shares by Country

Country	Low	Medium	High
Australia	34.3	32.2	33.4
Austria	28.0	35.2	36.9
Canada	36.5	31.4	32.0
Czech Republic	26.7	38.1	35.2
Denmark	26.8	32.7	40.5
England/N. Ireland (UK)	39.7	31.1	29.2
Estonia	28.8	37.9	33.3
Finland	24.7	31.7	43.6
Flanders (B)	25.7	32.1	42.2
France	43.8	31.0	25.2
Germany	31.9	31.5	36.6
Ireland	42.5	34.1	23.4
Italy	50.9	31.4	17.7
Japan	18.7	33.9	47.4
Korea	35.5	38.7	25.8
Netherlands	24.6	32.1	43.2
Norway	26.3	32.1	41.7
Poland	40.0	34.5	25.4
Slovak Republic	26.1	36.3	37.6
Spain	50.1	33.1	16.8
Sweden	25.6	32.3	42.1
United States	45.8	29.6	24.6

Broecke, Quintini and Vandeweyer 2016

Labor Force Skill Shares by Country: PIAAC Terciles 2012



Broecke, Quintini and Vandeweyer (2015)

A Cross-National Supply Demand Analysis: Demand Index

Demand index d_{kj}:

- Let c_{ok} be base emp share in country b in skill group κ in ind-occ cell o
- Industries: 1) Agriculture; 2) Mining, manufacturing, and construction; 3) Transportation, communications, and public utilities; 4) Trade; 5) Finance, insurance, real estate, and services; 6) Government
- Occupations: 1) Managers and professionals; 2) Clerical and sales workers; 3) Craft workers, operatives, laborers, and service workers

$$d_{kj} = \ln\left(1 + \sum_{0} c_{ok} \frac{\Delta E_{oj}}{E_{kb}}\right)$$

- where ΔE_{oj} is the country j minus country b Δ in emp share in industry-occupation o
- E_{kb} is emp share of skill group k in country b (equal to $\frac{1}{3}$)

Estimating Equation

Regressing rel. wage gap on rel. supply-demand gap:

- Define w_{kj} as the mean relative wage of skill group k relative to a base skill group in country j
- LOvO estimate the following model for relative wages:

$$(w_{kj} - w_{kb}) = \alpha + \beta \left[(s_{kj} - d_{kj}) - (s_{kb} - d_{kb}) \right] + \varepsilon_j$$

In fact, they do this as a diff-in-diff

- Let Δ equal the difference between two skill groups k (e.g., $w_{Hj} - w_{Lj}$ or $w_{Hj} - w_{Mj}$

$$(\Delta w_{kj} - \Delta w_{kb}) = \alpha + \beta \left[(\Delta s_{kj} - \Delta d_{kj}) - (\Delta s_{kb} - \Delta d_{kb}) \right] + \varepsilon_j$$

What's the expected sign of β?

Leuven et al: Fit Using Years of Schooling

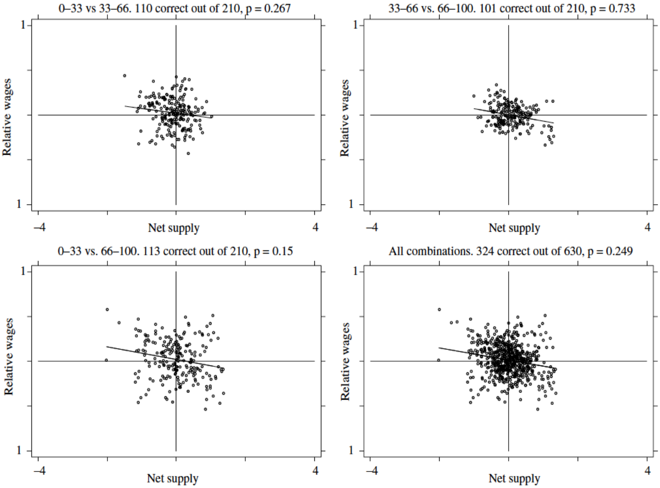


Fig. 2. *Relative Wages and Net Supply, S_{BK}*

Leuven, Oosterbeek and van Ophem, 2004

Leuven et al: Fit Using IALS Scores

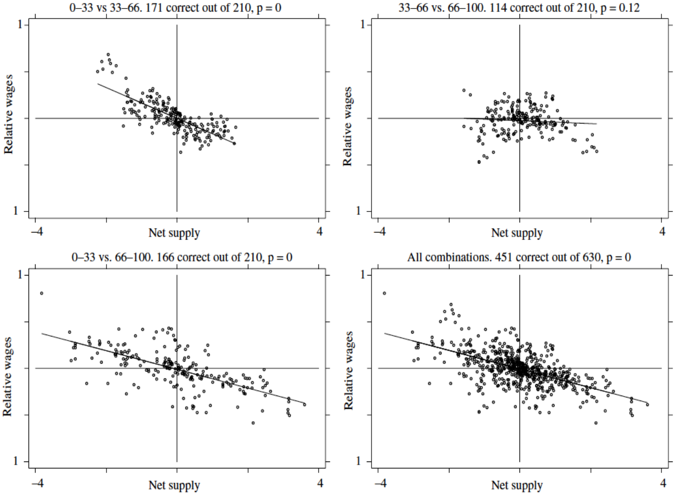
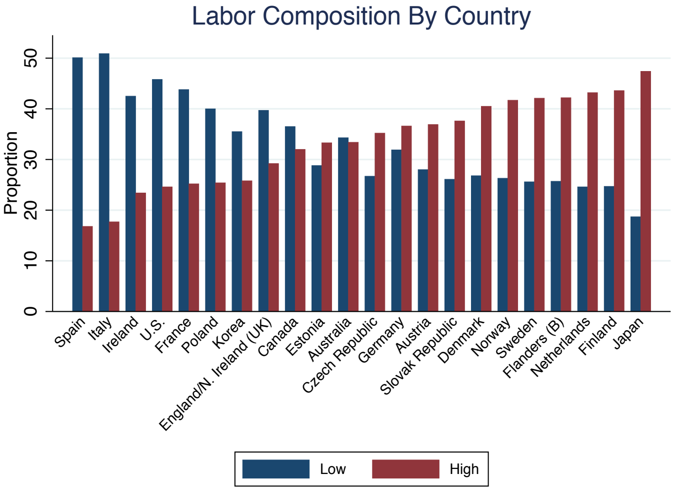


Fig. 3. *Relative Wages and Net Supply,* S_{IALS}

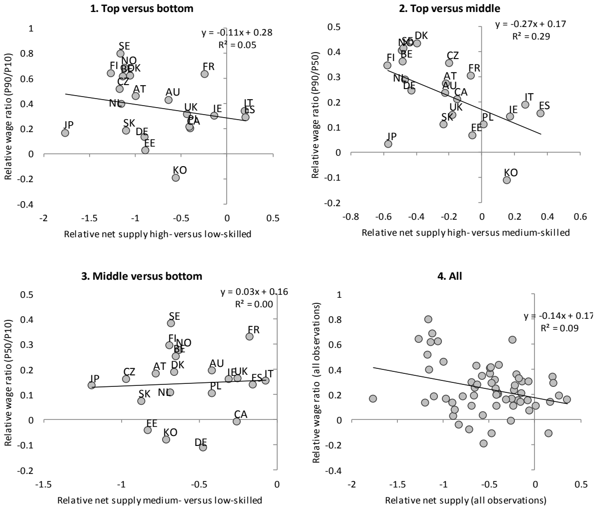
Leuven, Oosterbeek and van Ophem, 2004

Labor Force Skill Shares by Country: PIAAC Terciles 2012



Broecke, Quintini and Vandeweyer (2015)

LOvO Type Analysis Using PIAAC 2012



Broecke, Quintini and Vandeweyer (2015)

Cross-Country Regression: 90/50 (relative to U.S.)

Panel (ii) Dependent variable: P90/P50 (in logs, relative to US)

	(i)	(ii)	(iii)	(iv)	(v)	(vii)	(vii)
Net supply of skills (high v. medium)	-0.270**	-0.198*	-0.263**	-0.179***	-0.187***	-0.250**	-0.163***
	0.11	0.095	0.101	0.042	0.063	0.1	0.031
Statutory minimum wage (MW dummy)[a]		-0.178*					0.039
		0.088					0.075
Level of minimum wage[b] x MW dummy		-0.325					0.136
		0.285					0.226
Employment protection legislation[c]			-0.237**				-0.029
			0.11				0.109
Union coverage				-0.161***			-0.123***
				0.019			0.029
Size of public sector[d]					-0.207***		-0.105**
					0.045		0.048
Generosity of unemployment benefits[e]						-0.283***	-0.054
						0.08	0.047
Constant	0.170***	0.263***	0.006	-0.027	0.176***	0.073*	-0.028
	0.032	0.039	0.087	0.027	0.024	0.036	0.088
N	*21*	*21*	*21*	*21*	*21*	*21*	*21*
R^2	*0.288*	*0.507*	*0.385*	*0.812*	*0.657*	*0.539*	*0.889*
Adjusted R^2	*0.25*	*0.42*	*0.317*	*0.792*	*0.619*	*0.488*	*0.829*

Broecke, Quintini and Vandeweyer (2016)

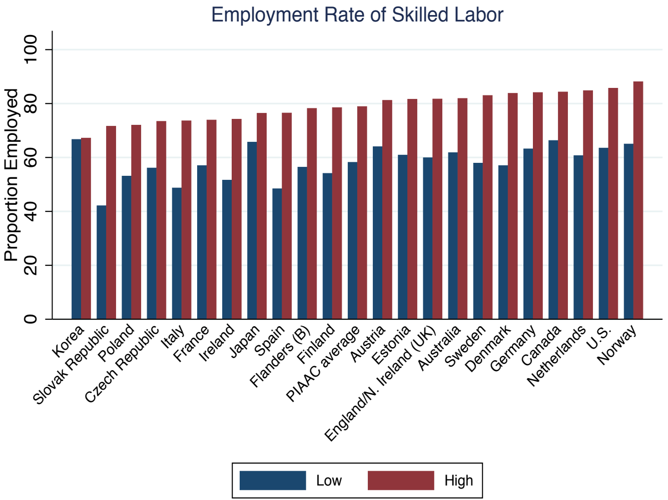
Cross-Country Regression: 50/10 (relative to U.S.)

Panel (iii) Dependent variable: P50/P10 (in logs, relative to US)

	(i)	(ii)	(iii)	(iv)	(v)	(vii)	(vii)
Net supply of skills (medium v. low)	0.027	-0.105	0.03	-0.053	-0.038	-0.003	-0.14
	0.07	0.084	0.066	0.066	0.086	0.079	0.08
Statutory minimum wage (MW dummy)[a]		-0.185**					-0.033
		0.081					0.096
Level of minimum wage[b] x MW dummy		-0.605**					-0.337
		0.227					0.213
Employment protection legislation[c]			-0.135				0.067
			0.157				0.185
Union coverage				-0.131***			-0.119*
				0.029			0.062
Size of public sector[d]					-0.182***		-0.101
					0.058		0.087
Generosity of unemployment benefits[e]						-0.153	0.091
						0.099	0.097
Constant	0.160***	0.135	0.067	-0.061	0.114**	0.089	-0.038
	0.048	0.079	0.097	0.057	0.05	0.061	0.12
N	*21*	*21*	*21*	*21*	*21*	*21*	*21*
R^2	*0.004*	*0.29*	*0.042*	*0.411*	*0.347*	*0.087*	*0.58*
Adjusted R^2	*-0.049*	*0.165*	*-0.065*	*0.346*	*0.274*	*-0.015*	*0.354*

Broecke, Quintini and Vandeweyer (2016)

Employment Rates of Top and Bottom Skill Terciles by Country: PIACC 2012



Broecke, Quintini and Vandeweyer (2016)

Employment Rates by Skill Terciles: PIAAC 2012

	Employment rate		
	Low-skilled	Medium-skilled	High-skilled
Australia	61.8	76.8	81.9
Austria	64.0	72.7	81.2
Canada	66.3	78.4	84.3
Czech Republic	56.1	65.0	73.4
Denmark	57.0	73.9	83.8
England/N. Ireland (UK)	59.9	74.4	81.7
Estonia	60.9	71.8	81.6
Finland	54.1	70.8	78.5
Flanders (B)	56.4	70.0	78.2
France	57.0	65.6	73.9
Germany	63.2	77.6	84.1
Ireland	51.6	64.5	74.2
Italy	48.7	59.2	73.6
Japan	65.7	70.1	76.4
Korea	66.7	68.1	67.2
Netherlands	60.7	75.9	84.8
Norway	65.0	77.7	88.1
Poland	53.1	63.3	72.0
Slovak Republic	42.1	62.8	71.6
Spain	48.4	64.9	76.5
Sweden	57.9	73.9	83.0
United States	63.5	78.4	85.7
PIAAC average	58.2	70.7	78.9

Broecke, Quintini and Vandeweyer (2016)

Oscars Reveal Widening Gap Between Best, Worst Dressed

the ONION®