Trade and Macroeconomics

Lectures 4: Trade and Labor Market Outcomes

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Trade and Wages

- a long-standing debate:
  - how do trade and offshoring affect wages and jobs of different workers?
  - can trade increase wage inequality and/or lower wages for some workers?
  - can trade increase unemployment?
- observations:
  - within-country wage inequality has increased in several countries in the past decades
  - wages of unskilled workers have stagnated
- some measures of within-country wage inequality:
  1. returns to college education
  2. skill premium $= \frac{\text{wage of white-collar workers}}{\text{wage of blue collar workers}}$
  3. residual wage inequality (after controlling for observable characteristics)

Some Cross-Country Evidence: Demand and Supply

Table 1: College Premium, Education and Openness

	Level in 2005			% Change 1980-2005		
	(1)	(2)	(3)	(4)	(5)	(6)
Country	College Premium	College Completed	Openness	College Premium	College Completed	Openness
Australia	1,72	20,6	40,8	19	20	91
Austria	1,38	10,7	104,1	-1	410	94
Canada	1,55	31,9	72,3	15	182	82
China	1,50	3,2	65,1	20	433	294
Denmark	1,47	11,4	93,2	1	27	98
Finland	1,53	15,0	79,4	-7	124	91
Italy	1,34	6,7	51,9	3	148	86
Japan	1,49	21,5	27,4	4	142	84
Mexico	1,80	12,5	55,1	30	221	262
Netherlands	1,58	16,8	131,3	-9	143	108
Spain	1,68	15,7	56,9	27	241	201
United Kingdom	1,61	11,9	56,5	5	98	77
United States	1,90	31,0	26,5	44	71	116
Average	**1,58**	**16,1**	**66,2**	**12**	**174**	**129**

Notes: Data on the college premium are from EU-KLEMS, Krueger et al. (2010) and Ge and Yang (2012). The change in the college premium for China refers to the period 1992-2007. Educational attainment and openness are from Barro-Lee and the Penn World Tables 7.1.

- both the college premium and skill supply have increased
  - demand must have increased

Main Explanations for Rising Demand for Skill

- main explanations:
  - Skill Biased Technical Change (SBTC)
  - globalization
- why globalization?
- timing:
  - the last globalization boom started in the late 1970s
- case studies:
  - Goldberg and Pavcnik (2007) $\rightarrow$ trade liberalization in 1980s-90s $\rightarrow$ rising skill premia in Mexico, Colombia, Argentina, Brazil, Chile, India
- cross-country evidence:
  - correlation between measures of wage inequality and a country openness $(\frac{import+export}{GDP})$ is often positive

Trade and Labor Market Outcomes

- focus on two main questions
  1. effect of trade and offshoring on wages (inequality)
  2. interaction between trade and unemployment
- roadmap:
  1. build a basic framework for studying the skill premium
  2. use it to study the effects of:
     - ★ technology
     - ★ trade
     - ★ offshoring
  3. extensions:
     - ★ residual inequality
     - ★ unemployment

A Basic 2x2 GE Framework

- preferences (CES):
  - $U = Y = \left[(Y_l)^{\frac{\epsilon-1}{\epsilon}} + (Y_h)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}, \quad \epsilon > 0$
  - Y_h = high-skill intensive good, price P_h
  - Y_l = low-skill intensive good, price P_l
- relative demand:
  - from profit maximization

$$\max_{Y_h, Y_l} \{ Y - P_h Y_h - P_l Y_l \}$$

$$FOCs \quad : \quad Y^{1/\epsilon} Y_h^{-1/\epsilon} = P_h \rightarrow \frac{Y_h}{Y_l} = \left(\frac{P_h}{P_l} \right)^{-\epsilon}$$

  - demand is a negative function of prices with elasticity: $-\frac{\partial \ln Y_h}{\partial \ln P_h} = \epsilon$
- production (specific factors):

$$Y_h = A_h H \quad \text{and} \quad Y_l = A_l L$$

  - H = supply of skilled workers, productivity A_h, wage w_h
  - L = supply of unskilled workers, productivity A_l, wage w_l

The Skill Premium

- perfect competition
  - price = marginal cost: $P_h = \frac{w_h}{A_h}$; $P_l = \frac{w_l}{A_l}$
- skill premium:

$$\frac{w_h}{w_l} = \frac{P_h}{P_l}\frac{A_h}{A_l} = \left(\frac{A_h}{A_l}\right)^{\frac{\epsilon-1}{\epsilon}} \left(\frac{L}{H}\right)^{\frac{1}{\epsilon}}$$

  - recall $\frac{P_h}{P_l} = \left(\frac{Y_h}{Y_l}\right)^{-1/\epsilon} = \left(\frac{A_h H}{A_l L}\right)^{-1/\epsilon}$
- determinants of the skill premium
  1. *technology*:
     - ★ if $\epsilon > 1$ (gross-substitutability), skill-biased technical change (higher $\frac{A_h}{A_l}$) increases $\frac{w_h}{w_l}$
  2. *endowments*:
     - ★ an increase in the relative supply of one factor reduces its relative reward, stronger effect when ϵ is low

Trade and the Skill Premium

- effect of trade:
  - similar to a change in endowments
- integrating two identical countries:
  - equal to doubling H and $L \longrightarrow$ no change in $\frac{w_h}{w_l}$
- N-S trade integration
  - between a skill-abundant North and a skill-scarce South*:

$$\begin{array}{ccccc} \frac{H}{L} & > & \frac{H^* + H}{L^* + L} & > & \frac{H^*}{L^*} \\ \frac{w_h}{w_l} & < & \left(\frac{w_h}{w_l}\right)^{trade} & < & \frac{w_h^*}{w_l^*} \end{array}$$

  - trade raises the reward of the relatively abundant factor
- problems:
  - volume of N-S trade too low (particularly in the 80s and 90s)
  - wage inequality increased also in many less-developed countries

Epifani & Gancia (2008)

- by adding IRS, models of new trade theory can explain:
  - why trade between identical countries may increase wage inequality
  - why trade may lead to a pervasive increase in skill premia
- same framework as before, but:
  1. skilled workers produce differentiated goods subject to IRS
  2. unskilled workers produce homogenous goods
- effect of trade: create bigger markets
  - differentiated goods are subject to IRS $\longrightarrow$ benefit more from bigger markets
  - skill is more valuable in large global markets

Skill-Intensive Sector

- Y_h is a CES baskets of differentiated varieties:

$$Y_h = \left[\int_0^n y_i^{\alpha} di \right]^{1/\alpha}, \quad \alpha \in (0,1)$$

  - $n =$ number of varieties (endogenous)
  - $\sigma = 1/(1-\alpha) > 1 =$ elasticity of substitution between varieties

- demand for any variety y_i
  - solve:

$$\max_{y_i} P_h Y_h - \int_0^n p_i y_i di$$

  - to get:

$$y_i = \left(\frac{p_i}{P_h} \right)^{-\sigma} Y_h$$

  - demand with price elasticity $\sigma = 1/(1-\alpha)$

Firms - Monopolistic Competition

- one firm = one variety, total cost function:

$$TC = (f + \beta y_i) w_h$$

  - f = fixed cost, β = variable cost, *all costs in units of labor*
  - price = markup over MC:

$$p = \frac{\beta w}{\alpha}$$

  - simplification: $\beta = \alpha \rightarrow p = w$

- free entry ($\pi = 0$):

$$(p - cw_h)\, y_i = w_h F \rightarrow y = \frac{f}{1 - \beta}$$

  - pins down firm scale
  - simplification: $f = 1 - \beta$ to get $y = 1$

Varieties and Productivity

- labor marker clearing (demand = supply):

$$(f + \beta y)n = H \rightarrow n = H$$

  - with a fixed y, a higher H increases the number of firms only

- production of Y_h:

$$Y_h = \left[\int_0^n y_i{}^{\alpha} di\right]^{1/\alpha} = n^{1/\alpha} = H^{1/\alpha}$$

  - Y_h increases with n (love of variety) and thus with H :

$$\frac{\partial \ln Y_h}{\partial \ln H} = \frac{1}{\alpha} > 1$$

  - Increasing Returns to Scale

- production of Y_l: $Y_l = L$
  - homogeneous good under perfect competition ($A_l = 1$)

Trade and the Skill Premium

- new effect of trade:
  - a bigger market can sustain a larger number of firms/varieties
  - new gains from variety (IRS) $\longrightarrow$ a productivity effect!
- effect on the skill premium:
  - all revenue goes to workers (zero profit), thus $\frac{w_h H}{w_l L} = \frac{P_h Y_h}{P_l Y_l}$
  - using $\frac{P_h}{P_l} = \left(\frac{Y_h}{Y_l}\right)^{-1/\epsilon}$, $Y_h = H^{1/\alpha}$ and $Y_l = L$:

$$\frac{w_h}{w_l} = L^{1/\epsilon} H^{\frac{\epsilon-1-\alpha\epsilon}{\alpha\epsilon}}$$

- if $\epsilon > 1$, integrating two identical countries raises $\frac{w_h}{w_l}$
  - why? because trade increases "productivity" in the skill-intensive sector!
- if $\epsilon > \sigma = 1/(1-\alpha)$, the scale effect is so strong that trade *always* increases the skill-premium
  - an increase in H creates its own demand (new products)

Offshoring and Wages

- introduce offshoring as in:
  - Grossman & Rossi-Hansberg (2006, 2008)
  - Acemoglu, Gancia & Zilibotti (2013)
- focus on offshoring of L-jobs (more relevant case)
  - production of Y_l requires intermediates that can be separated geographically
  - benefit of offshoring: move production to low-wage countries (South)
  - but only a fraction $\kappa < \bar{\kappa} = \frac{L^*}{L+L^*}$ of intermediates can be offshored
- new result:
  - offshoring of unskilled jobs can, in some cases, benefit domestic unskilled workers!

Introducing L-Offshoring

- preferences:

$$Y = \left[(Y_l)^{\frac{\epsilon-1}{\epsilon}} + (Y_h)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}}$$

  - where:

$$Y_l = \left[\int_0^1 y_i{}^{\alpha} di \right]^{1/\alpha} = \left[(1-\kappa)^{1-\alpha} L^{\alpha} + \kappa^{1-\alpha} (L^*)^{\alpha} \right]^{1/\alpha}$$

  - $y_i^* = \frac{L^*}{\kappa}$, $i \in [0, \kappa]$ are offshored to the South
  - $y_i = \frac{L}{1-\kappa}$, $i \in (\kappa, 1]$ are produced in North
  - no offshoring in the H sector: $Y_h = H$

- perfect competition:

  - wages = MPL

$$w_h = \frac{\partial Y}{\partial H} = Y^{1/\epsilon} Y_h^{-1/\epsilon}$$

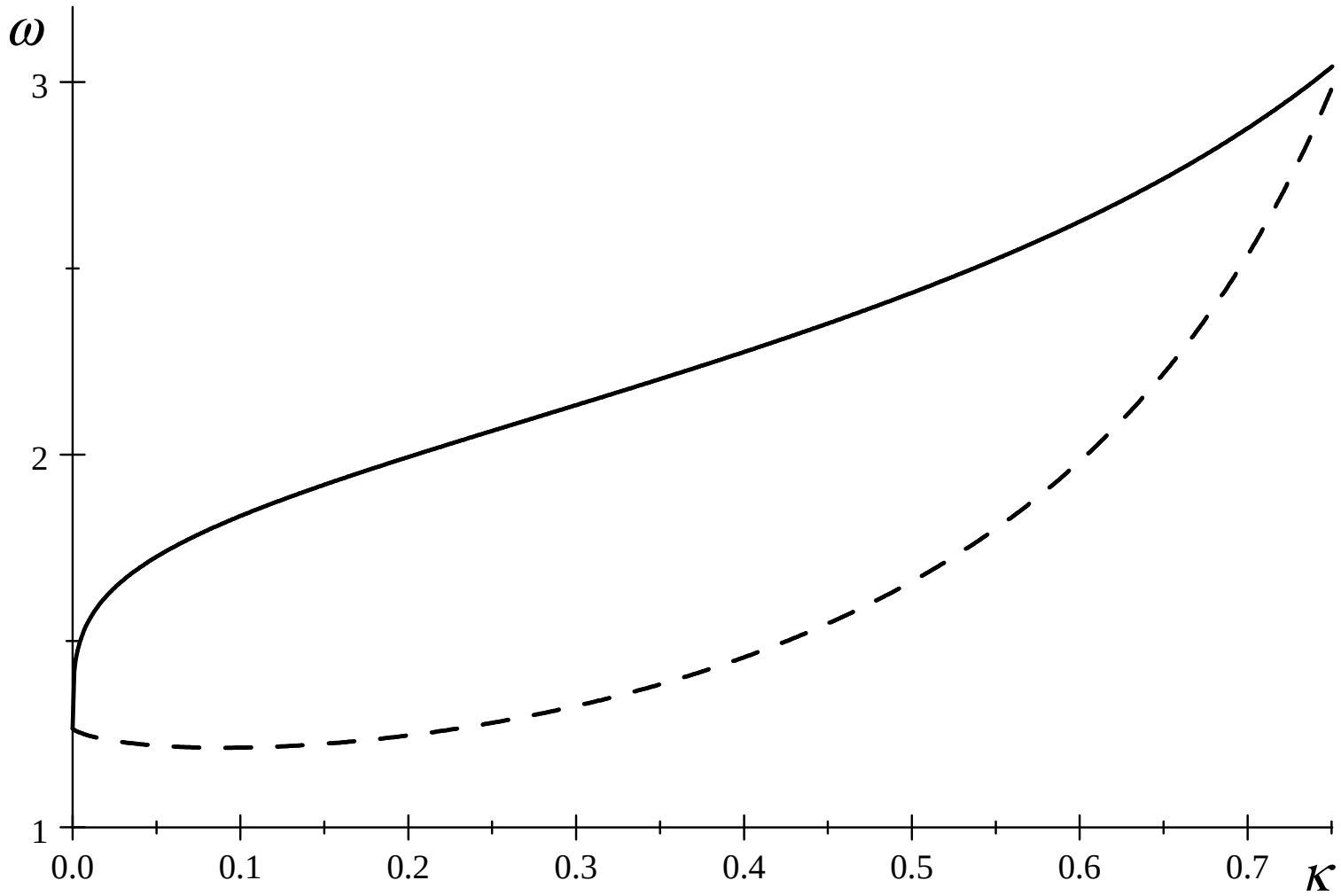
$$w_l = \frac{\partial Y}{\partial L} = Y^{1/\epsilon} Y_l^{-1/\epsilon} Y_l^{1-\alpha} (1-\kappa)^{1-\alpha} L^{\alpha-1}$$

L-Offshoring and the Skill Premium

$$\frac{w_h}{w_l} = \frac{L^{1-\alpha}}{Y_h^{1/\epsilon}} \cdot \frac{(1-\kappa)^{\alpha-1}}{Y_l^{1-1/\epsilon-\alpha}}$$

- effects of κ:
  1. direct effect: less demand for L in North $\longrightarrow$ higher skill premium
  2. efficiency effect: higher $Y_l \longrightarrow (?)$
- if tasks are sufficiently complementary ($\alpha < 1 - 1/\epsilon$)
  - $\frac{w_h}{w_l}$ is a U function of κ
  - why? recall $\frac{\partial Y_l(\kappa \simeq 0)}{\partial \kappa} \longrightarrow \infty$, and $\frac{\partial Y_l(\kappa \simeq \bar{\kappa})}{\partial \kappa} \longrightarrow 0$
- intuition:
  - with enough complementarity, cost saving on $[0, \kappa]$ increases the demand for workers on $(\kappa, 1]$ too $\longrightarrow$ lower skill premium
  - but this effect disappears as $w_l^* \longrightarrow w_l$
- Grossman & Rossi-Hansberg (2006, 2008)
  - ICT increases foreign productivity $\longrightarrow$ lowers $\frac{w_h}{w_l}$ if $\alpha < 1 - 1/\epsilon$

L-Offshoring and the Skill Premium



- $\epsilon = 1.6$, solid: $\sigma = 5$, dashed: $\sigma = 1.25$, $\sigma = 1/(1-\alpha)$

Feenstra & Hanson (1997, 1999)

- the removal of barriers to Foreign Direct Investment has triggered offshoring from US to Mexico
- this relocation of economic activity can increase wage inequality in both countries
- why?
  - because offshored activity are low-skill intensive relative to US production
  - but they are skill-intensive relative to Mexican production
- thus, the skill-intensity of production (and thus the demand for skill) increases both in US and Mexico

Trade and Wages with Heterogeneous Firms and Workers

- Helpman, Itskhoki & Redding (2010)
  - Melitz (2003) + labor market frictions $\longrightarrow$ wage dispersion, unemployment
- key ingredients:
  - monopolistic competition with heterogeneous firms
  - fixed cost of exporting
  - labor market frictions
    - ★ random search and matching ($\longrightarrow$ rent sharing between firms and workers)
    - ★ unobservable worker ability heterogeneity
    - ★ costly screening by firms
- main results:
  - trade benefits disproportionately more productive firms
  - more productive firms pay higher wages
  - trade increases wage inequality and may increase unemployment

Market Structure

- monopolistic competition as in Melitz (2003)
  - fixed entry cost, f_e
  - productivity draw $\theta \sim \text{Pareto}(z)$
  - fixed production cost, f_d
  - fixed export cost, f_x
- revenue per firm:

$$r(\theta) = r_d(\theta) + r_x(\theta) = (A + I_x A^*)\, y\,(\theta)^{\beta}$$

  - $r_d(\theta)$, $r_x(\theta)$ = revenue from home and foreign market
  - A and A^* capture home and foreign demand conditions
  - $I_x = 1$ if firm exports, 0 otherwise
  - downward sloping demand curve

Technology

- output of firm with θ productivity, h employees of average ability $\bar{a}$:

$$y = \theta h^{\gamma} \bar{a},$$

  - $\gamma \in (0,1) \rightarrow$ DRS (e.g., span of control model)
  - ability a unobservable and Pareto: $G_a(a) = 1 - (1/a)^k$
- firm pays bn to match randomly with $n \geq h$ workers
- firm pays $\frac{ca_c^{\delta}}{\delta}$ to screen out workers with $a < a_c$

$$\bar{a} = \frac{k}{k-1} a_c \quad \text{and} \quad h = n \left(\frac{1}{a_c} \right)^k$$

  - assume $k < 1/\gamma$ (screening will be profitable)

Firm's Problem

- wage bargaining as in Stole & Zwiebel (1996):
  - firm's share of revenues $= 1/(1+\beta\gamma)$
- firm solves

$$\pi(\theta) = \max_{n,\, a_c,\, I_x} \left\{ \frac{r(\theta)}{1+\beta\gamma} - bn - \frac{c(a_c)^{\delta}}{\delta} - f_d - I_x f_x \right\}$$

  - where $r(\theta) = (A + I_x A^*) \left(\frac{k}{k-1} \theta n^{\gamma} a_c^{1-\gamma k} \right)^{\beta}$

$$\text{FOC for } n \quad : \quad \frac{\beta\gamma}{1+\beta\gamma} r(\theta) = bn(\theta)$$

$$\text{FOC for } a_c \quad : \quad \frac{\beta(1-\gamma k)}{1+\beta\gamma} r(\theta) = c(a_c(\theta))^{\delta}$$

  - more productive firms:
    - ★ sample more workers, $n'(\theta) > 0$
    - ★ screen at a higher ability threshold, $a_c'(\theta) > 0$
  - $\theta < \theta_d$ exit and $\theta > \theta_x$ export

Profits, Cutoffs and Wages

- profits:
  - using the FOCs:

$$\pi(\theta) = \Gamma\left[r_d(\theta) + I_x r_x(\theta)\right] - f_d - I_x f_x$$

    - ★ $\Gamma = \frac{1-\beta\gamma-\beta(1-\gamma k)/\delta}{1+\beta\gamma}$
  - productivity cutoffs

$$\begin{aligned} \theta_d &: \Gamma r_d(\theta_d) = f_d \\ \theta_x &: \Gamma r_x(\theta_x) = f_x \end{aligned}$$

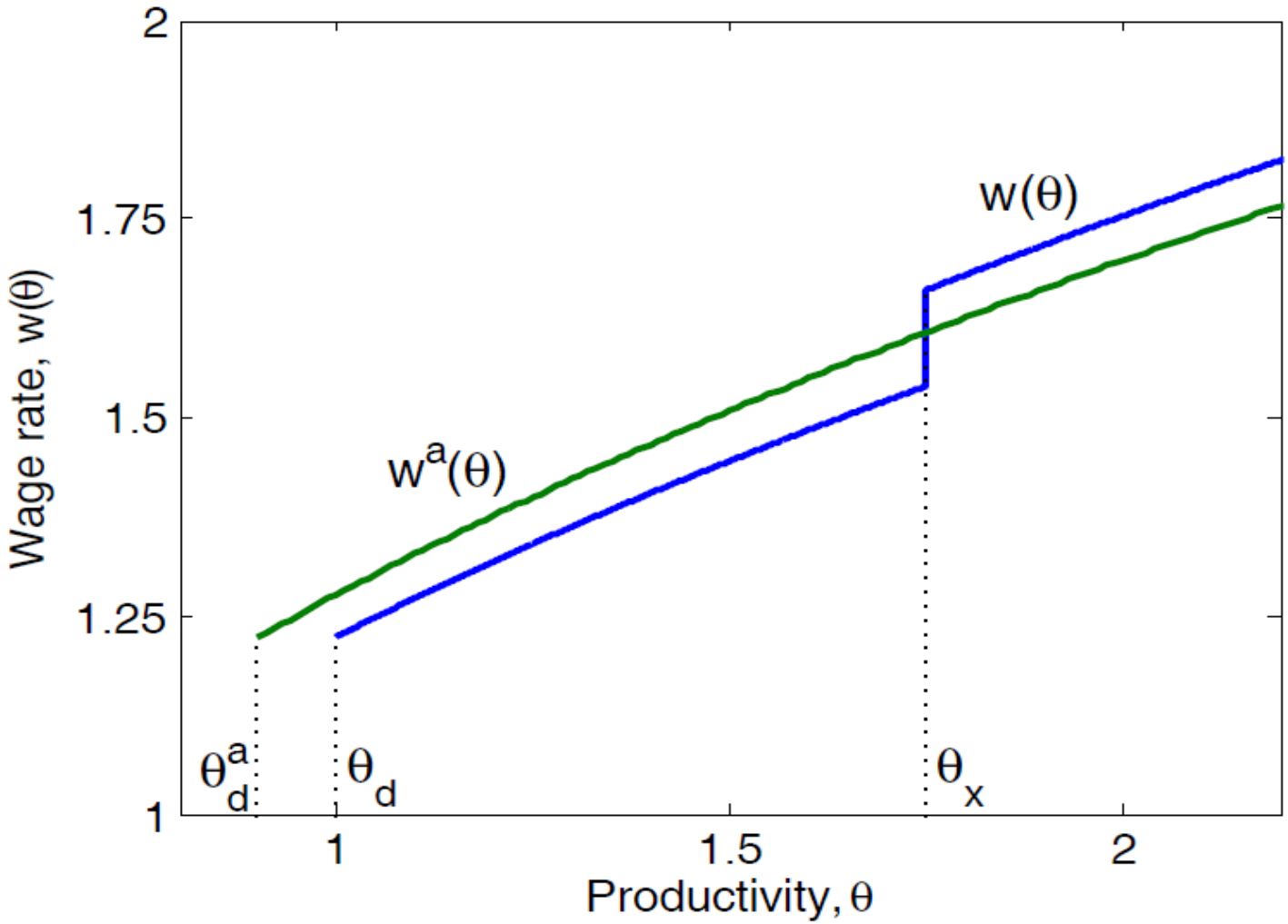
  - profit increases smoothly in θ, revenue jumps for exporters to cover f_x
- wages:
  - from FOC + $h = n a_c^{-k}$:

$$w(\theta) h(\theta) = \frac{\beta\gamma}{1+\beta\gamma} r(\theta) = b n(\theta) \rightarrow w(\theta) = b\left[a_c(\theta)\right]^k$$

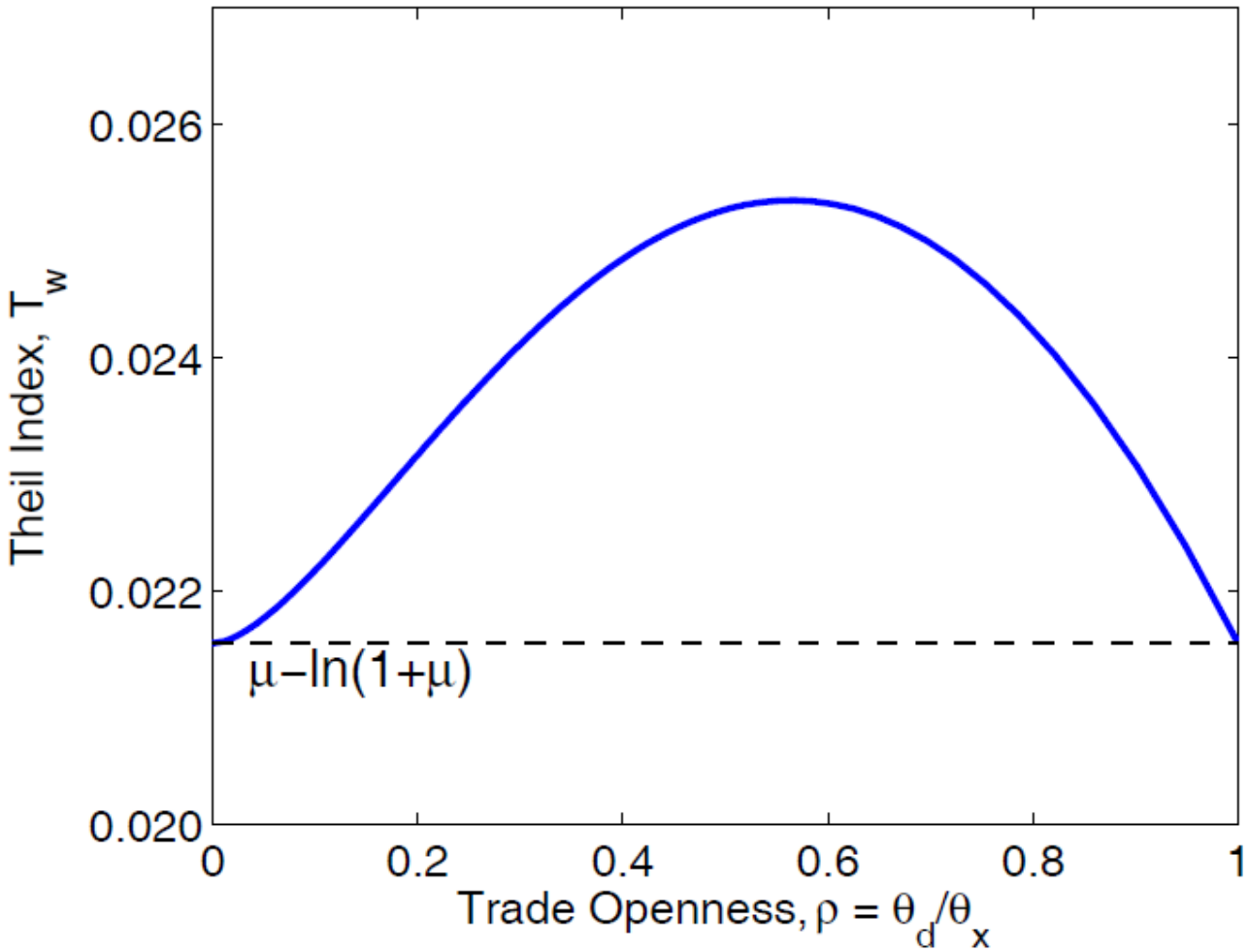
  - more productive firms pay higher wages + exporter wage premium

Wage Profiles

- open economy versus autarky:



Openness and Wage Inequality



Trade and Unemployment

- tightness x depends on labor supply decisions
  - indifference between seeking a job (with unemployment risk) and a safe outside option ω :
$$\omega = \frac{N}{L}\frac{wh}{n} = \frac{N}{L}b$$
  - L = total job seekers
  - N = total sampled workers
- employment rate:
$$\frac{H}{L} = \frac{H}{N}\frac{N}{L} = \frac{H}{N}\frac{\omega}{b}$$
  - H = total hired workers
  - given (ω, b), $\frac{H}{L}$ is higher in a trade equilibrium than in autarky
    - ★ why? trade reallocate workers towards more productive firms
    - ★ but more productive firms are more selective $(h/n = a_c^{-k})$
  - trade may increase unemployment

Further Readings

- some supportive evidence:
  - Helpman-Itskhoki-Muendler-Redding (2014) $\longrightarrow$ structural estimation using Brazilian data
  - Amiti & Davis (2011) $\longrightarrow$ similar results with fair wages, supportive evidence from Indonesia
- Helpman & Itskhoki (2010):
  - differences in labor market institutions may be a source of Comparative Advantage
  - trade may affect unemployment by changing the sectorial composition of the economy (specialization)
  - labor market reforms may affect foreign countries through trade linkages
- Trade, Sorting and Inequality:
  - Ohnshorge & Trefler (2007), Costinot & Vogel (2010), Monte (2011), Sampson (2012)
- Offshoring, Sorting and Inequality:
  - Antras, Garicano & Rossi-Hansberg (2006), Kremer & Maskin (2006)

Trade and Unemployment

- countries differ in labor market institutions:
  - how does trade interact with (different) labor market institutions?
- Davis (1998)
  - before the 70s, unemployment in Europe was $\sim 2-3\%$, now it's much higher
  - European labor markets are rigid
  - claim: globalization + rigidity $\longrightarrow$ higher European unemployment
- trade model with two factors (H and L) and two countries:
  - US: flexible wages
  - Europe: binding minimum wage for unskilled workers
  - result: Europe-US trade can increase European unemployment

Wages and Unemployment

- flexible wages
  - recall: $\frac{w_h}{w_l} = \left(\frac{A_h}{A_l}\right)^{\frac{\epsilon-1}{\epsilon}} \left(\frac{L}{H}\right)^{\frac{1}{\epsilon}}$
  - normalize $w_h = 1$ and $\left(A_h/A_l\right)^{\frac{\epsilon-1}{\epsilon}} = a$

$$w_l^* = a^{-1}\left(H/L\right)^{1/\epsilon}$$

  w_l^* wage consistent with market clearing
- rigid wages
  - binding minimum wage, $\bar{w}_l > w_l^*$

$$\bar{w}_l = a^{-1}\left(H/L^e\right)^{1/\epsilon}$$

    where $L^e = L - U$ is employed unskilled workers
  - unemployment:

$$U = L - H\left(a\bar{w}_l\right)^{-\epsilon}$$

  - at $\bar{w}_l > w_l^*$ firms are not willing to employ all L

Trade and European Unemployment

- assume Europe (rigid) and US (flexible) have the same L and H
  - free-trade unemployment:

$$U_E = 2\left[L - \frac{H}{(a\bar{w}_l)^{\epsilon}}\right], \qquad U_{US} = 0$$

  - trade with the US doubles unemployment in Europe
- why?
  - wages are flexible in US: if $U_{US} > 0 \rightarrow$ firms can hire more workers and offer them $w_l < \bar{w}_l$
  - but European firms cannot compete with firms paying $w_l < \bar{w}_l$
  - European firms will fire workers until $w_l = \bar{w}_l$ and all U is in Europe
- other global events can raise European unemployment:
  - immigration of L to the US
  - SBTC ($a \uparrow$)

What Did We Learn?

- trade (even between similar countries) may lead to higher wage inequality
- trade/offshoring can have effects similar to (biased) changes in productivity
  - trade may increase relatively more the productivity of skilled workers
  - offshoring of labor-intensive tasks may increase the efficiency of unskilled sectors
  - may be difficult to distinguish empirically between trade and biased technical change
- rich interaction between trade and labor market institutions:
  - trade can make labor market rigidity more costly (through price effects)
  - or less costly (through specialization)