Open Borders in the European Union and Beyond

John Kennan
University of Wisconsin-Madison and NBER

October 2016

The Economics of Immigration

What would happen if we let people choose where they want to live?

- The immigrants who would not otherwise have moved would be better off.
- By how much?
- Who would lose, and how much?
- Would skilled workers gain at the expense of unskilled workers?

The European Union has tried this. What can be learned from EU data?

Literature

Trefler, “International Factor Price Differences: Leontief was Right!”, *JPE* (1993)
Hendricks, “How Important Is Human Capital for Development? Evidence from Immigrant Earnings”, *AER* (2002)
Caselli and Feyrer, "The Marginal Product of Capital", *QJE* (2007)
Klein and Ventura, “Productivity differences and the dynamic effects of labor movements”, *JME* (2009)
Kennan and Walker, “The Effect of Expected Income on Individual Migration Decisions,” *ECMA* (2011)
Kennan, “Open Borders,” *RED*, April 2013
di Giovanni, Levchenko and Ortega, “A Global View of Cross-Border Migration”, *JEEA* (2015)
Clemens, Montenegro and Pritchett, “The place premium: wage differences for identical workers across the US border” (2009).

Literature

Borjas, “Immigration and Globalization: A Review Essay,” *JEL*, (December 2015)

> “Beware of social engineers who promise the existence of trillion-dollar bills on a mythical sidewalk at the end of the rainbow; those promises are often based on flimsy modeling and inadequate evidence.”

Outline

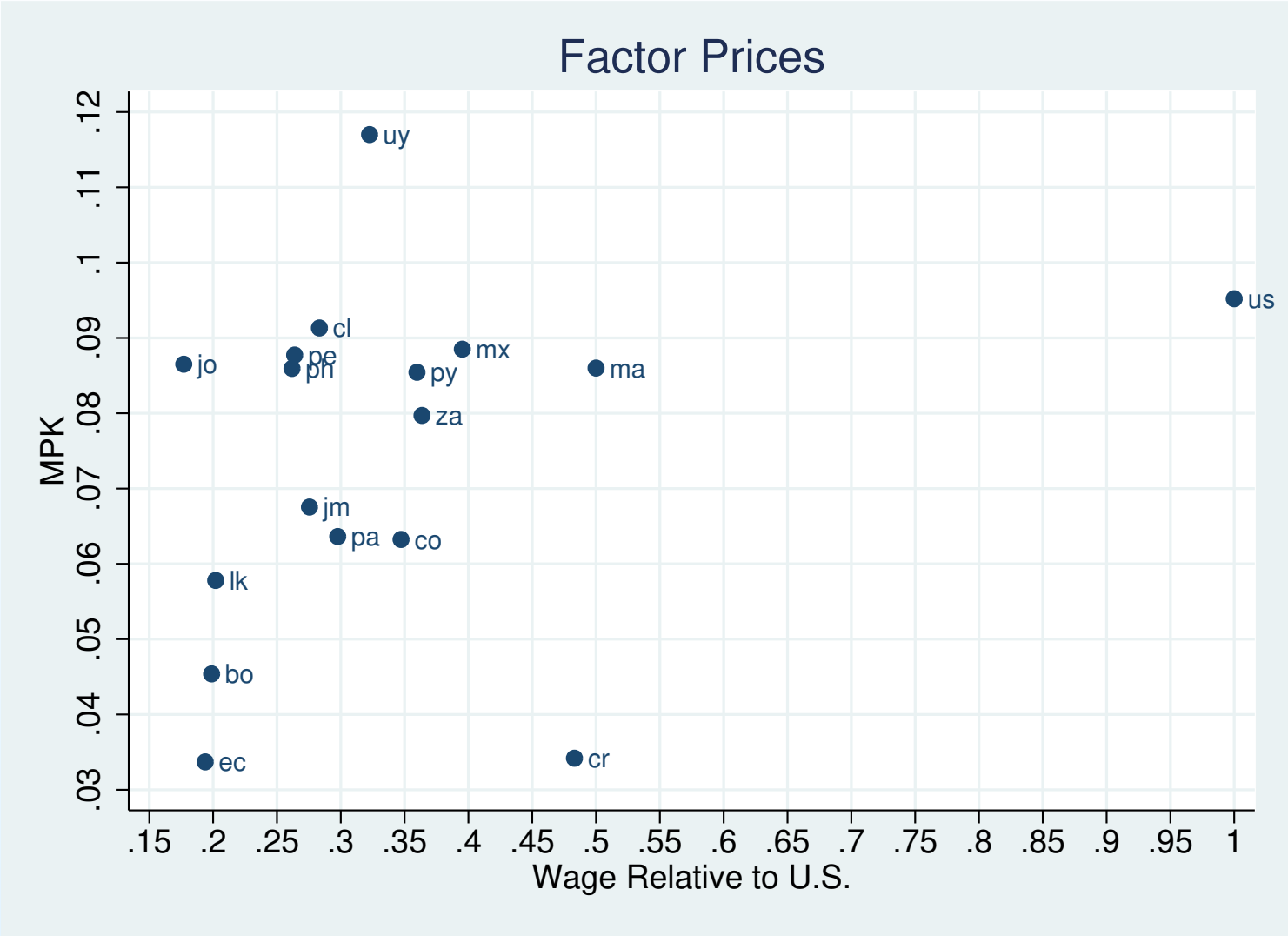
1. Flimsy modeling
2. Inadequate evidence

International Wage Differentials

Clemens, M.A. and Montenegro, C.E. and Pritchett, L., “The place premium: wage differences for identical workers across the US border” (2009).

Foreign-born, foreign-educated workers in the U.S. Census compared with similar workers in 42 home countries

Wages and the Marginal Product of Capital

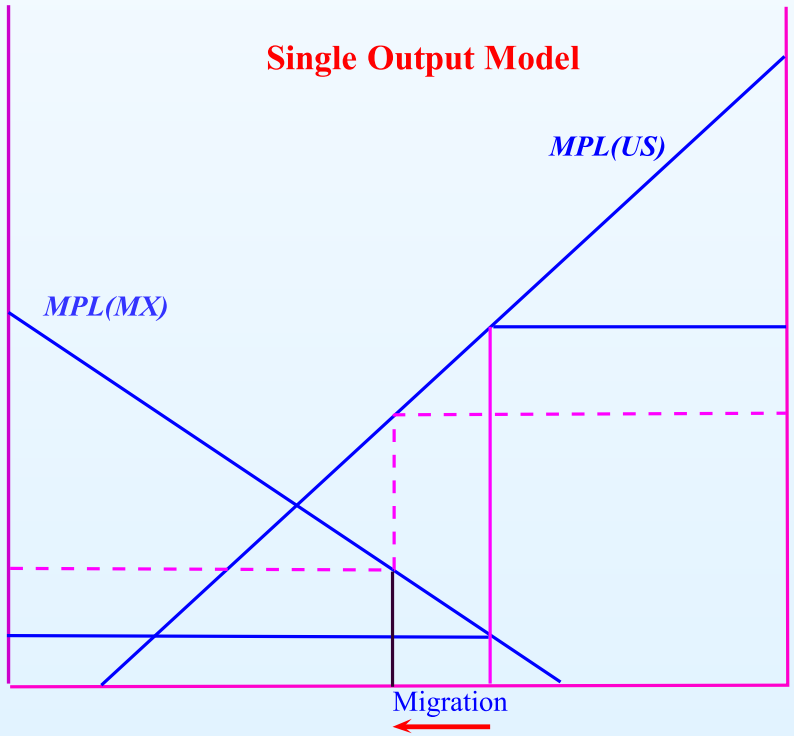


Standard (One-Good) Model

"the very large wage ratios we observe for many countries are sustained by policy barriers to movement" [Clemens et al, (2008)]

"In theory, moving labor from a poor to rich country ... lowers (raises) incomes for laborers in the receiving (sending) country" [Hanson (2010)]

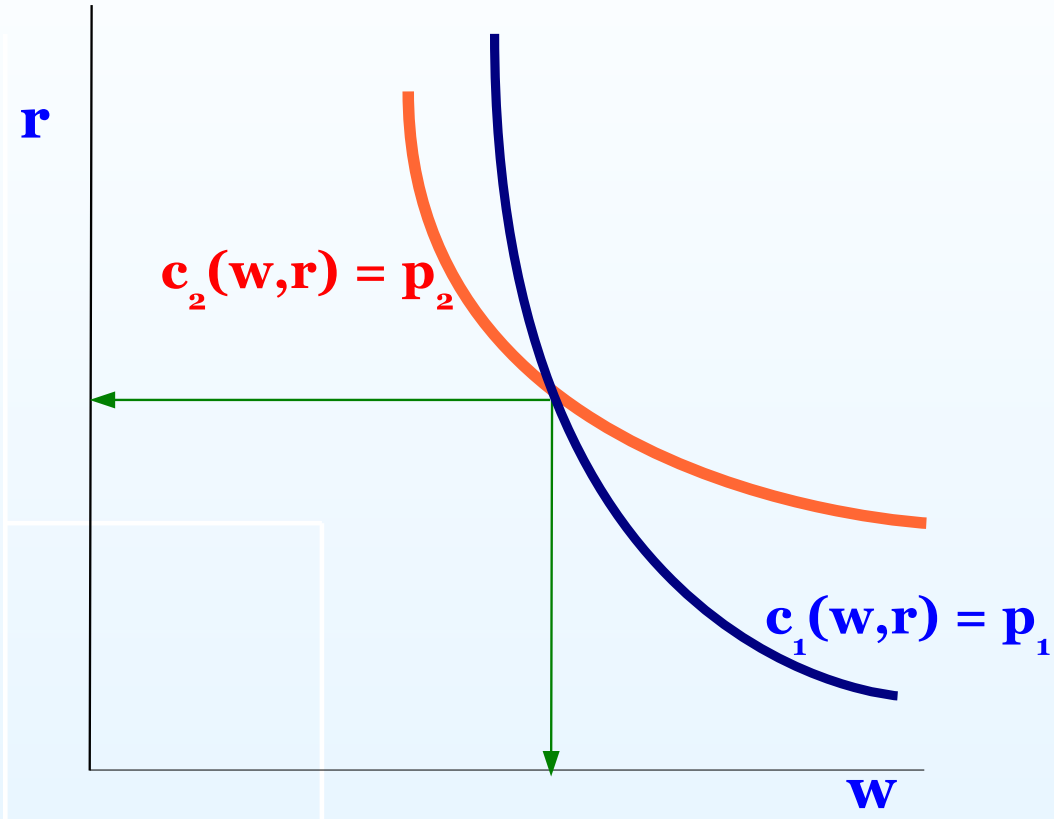
Not in the HO model: removing the barriers has no effect on wage ratios; emigration does not raise wages



Wage Effects

What if there is more than one product?
The Rybczynski theorem says that an increase in the supply of one factor leads to an increase in the production of goods that use that factor intensively (and a decrease in the production of other products),
with no effect on relative factor prices.
This is in a small open economy that takes product prices as given.
What are the effects of changing the skill mix in a big open economy?

Factor Price Equalization



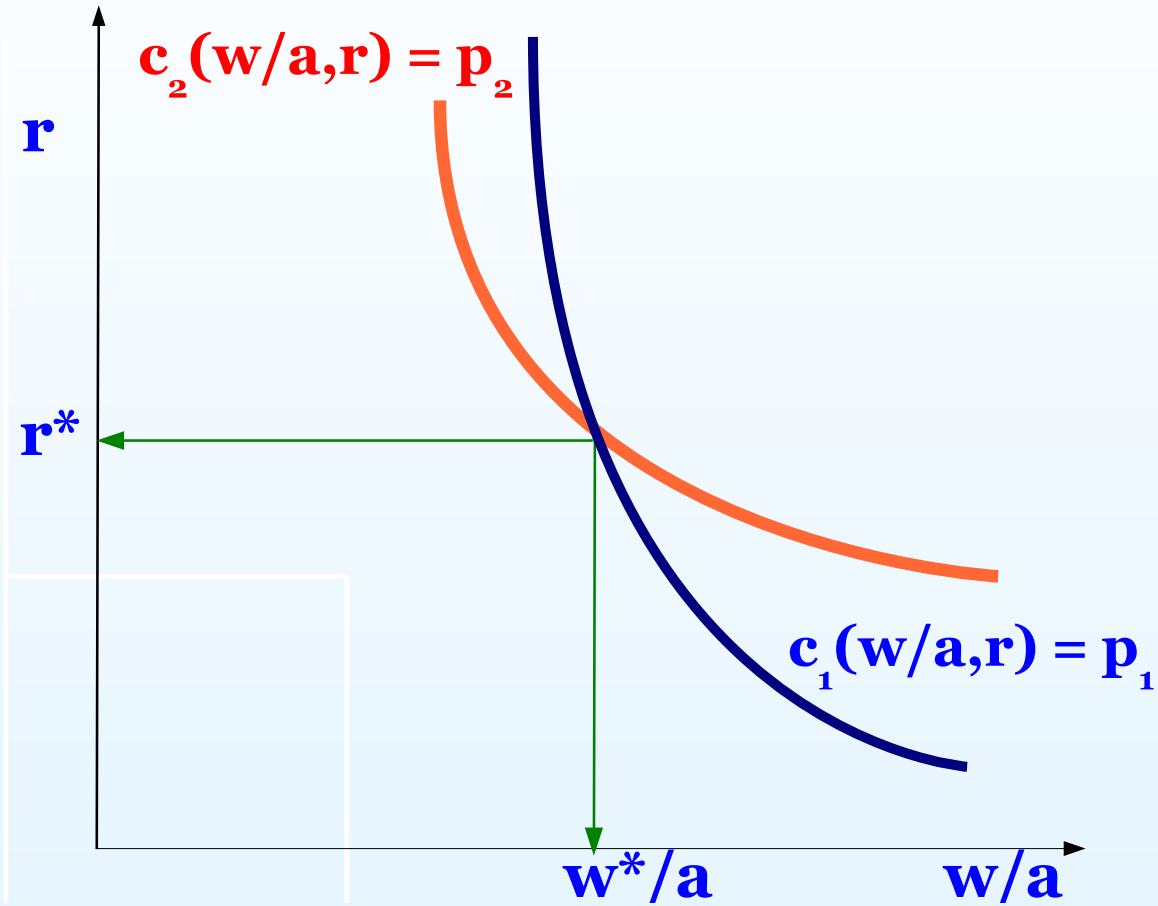
Two locations, Two products

Producers like lower wages (w) and lower capital prices (r)

Equilibrium: producers of each good indifferent between (w_1, r_1) and (w_2, r_2)

Two orderings of (w, r): Two prices needed to get indifference

Factor Price Equalization with Productivity Differences



$\frac{w}{a}$: wage per efficiency unit of labor

Factor Price Equalization: Labor-Augmenting Productivity Differences

J countries, with different productivity levels.
Productivity differences are labor-augmenting (Harrod-neutral)
(equivalent to TFP differences in the *1-product* Cobb-Douglas case)
Production function for product r in country j

$$Q_r^j = F_r\left(K_r^j, a_{j1}S_r^j, a_{j2}U_r^j\right)$$

(a_{js}) efficiency units of labor per worker in country j (same for all products)
No mobility of capital or labor across countries
Cost function for product r in country j

$$c_r^j\left(v, w\right) = c_r^0\left(v, \frac{w_j^S}{a_{j1}}, \frac{w_j^U}{a_{j2}}\right)$$

where w is the wage per efficiency unit of labor, and v is the price of capital
c_s^0 is the unit cost function when labor is measured in efficiency units

Factor Price Equalization with Productivity Differences

Free trade in product markets, no transport costs

Zero-profit condition implies

$$p_r = c_r^0\left(v, \frac{w_j^S}{a_{j1}}, \frac{w_j^U}{a_{j2}}\right)$$

If three products are produced in country j, then

$$\begin{aligned} c_1^0\left(v_j, \frac{w_j^S}{a_{j1}}, \frac{w_j^U}{a_{j2}}\right) &= p_1 \\ c_2^0\left(v_j, \frac{w_j^S}{a_{j1}}, \frac{w_j^U}{a_{j2}}\right) &= p_2 \\ c_3^0\left(v_j, \frac{w_j^S}{a_{j1}}, \frac{w_j^U}{a_{j2}}\right) &= p_3 \end{aligned}$$

These three equations determine the factor prices in country j.

If the marginal rates of technical substitution satisfy a single-crossing condition, the factor prices are uniquely determined

Factor Price Equalization with Productivity Differences

If country ℓ also produces these same three products,
the same equations determine factor prices in country ℓ (with a_ℓ in place of a_j)
This implies $v_j = v_\ell$, and

$$\frac{w_j^S}{a_{j1}} = \frac{w_\ell^S}{a_{\ell 1}}$$

Thus

$$\begin{aligned} w_j^S &= a_{j1} w_0^S \\ w_j^U &= a_{j2} w_0^U \end{aligned}$$

where w_0 is a reference wage level that can be normalized to 1.
In this model, migration has no effect on relative wages.

Simple Migration Model

Proportion of people who move determined by the relative wage
– the ratio of income at home (y_{js}) to the highest income elsewhere (y_{0s})
– for someone at skill level s
Assume utility is loglinear, so indirect utility is $\log(y)$. Stay if

$$\log(y_{0s}) - \delta_s \leq \log(y_{js})$$

δ_s: disutility of moving (attachment to home), randomly distributed over people
Assume the distribution of δ is exponential: $F_s(t) = 1 - e^{-\omega_s t}$
Then the probability of staying is

$$\text{Prob}\left(\delta \geq \log\left(\frac{y_{0s}}{y_{js}}\right)\right) \quad = \quad e^{-\varsigma_s \log\left(\frac{y_{0s}}{y_{js}}\right)} = (a_j)^{\omega_s}$$

So if the proportion who stay is $\mathcal{S}_{js}$ then

$$\log(\mathcal{S}_{js}) = \omega_s \log(a_{js})$$

Immigration and Wages

- A relaxation of immigration restrictions leads to a fall in the real wage
- The wage effect is the same in all (both sending and receiving) countries
- but migration reduces the wage per efficiency unit (and so reduces the wage of all non-migrants)
- Prices of labor-intensive goods fall relative to capital-intensive goods
- but the real wage falls regardless of the composition of consumption
- If $\bar{L}$ doubles the factor price ratio also doubles (Cobb-Douglas)
- So if the capital share for good s is $\alpha_s = \frac{1}{3}$,
- the real wage falls by about 20% when measured in terms of good s.
- Migration increases the wages of (most) migrants

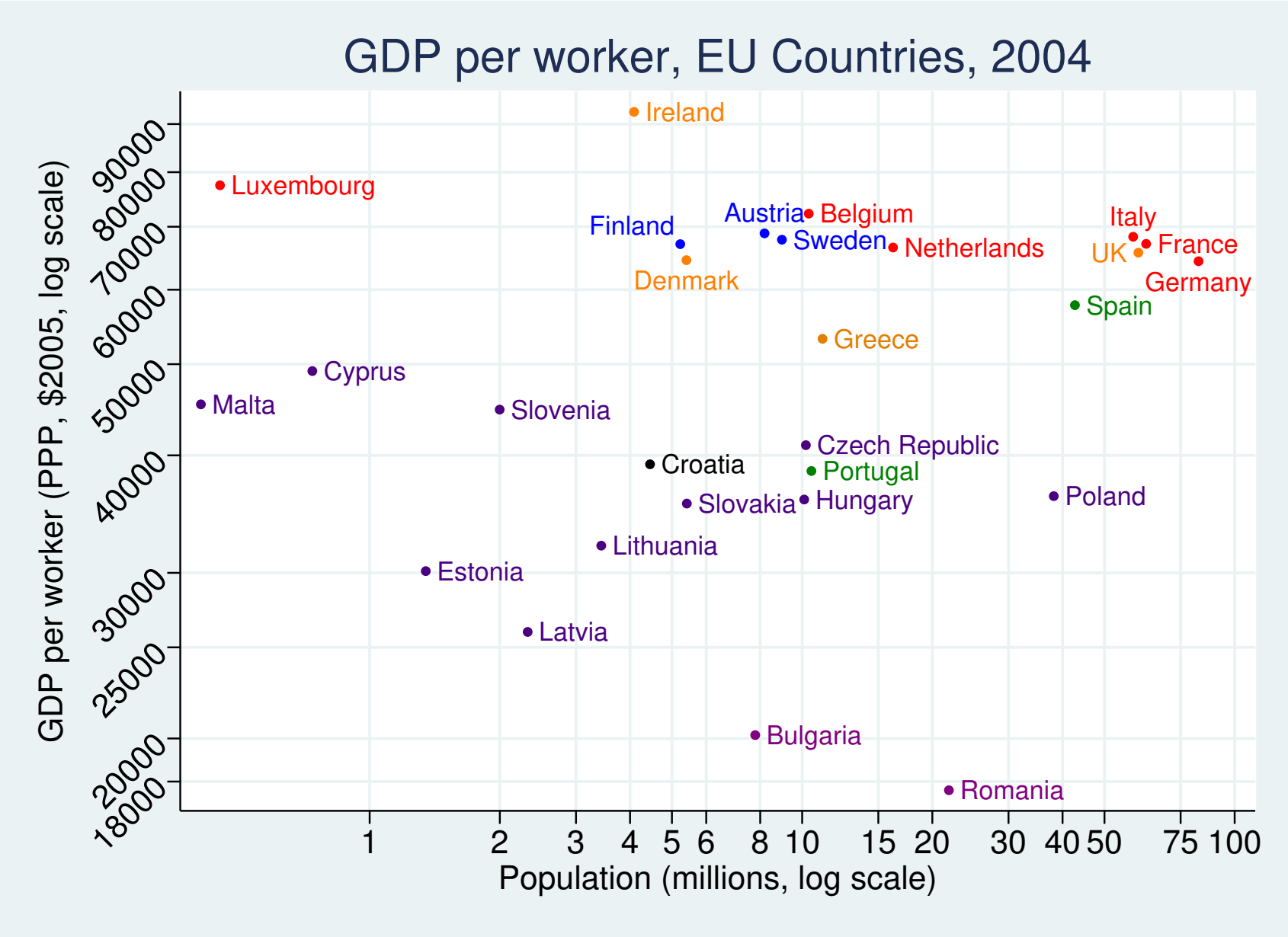
The European Union: Entry and Exit

The European Union, $1958 - 2004$					
1958	1973	1981	1985	1986	1995
Belgium	Denmark	Greece	~~Greenland~~	Portugal	Austria
France	[Greenland]			Spain	Finland
Germany	Ireland				Sweden
Italy	UK				
Luxembourg					
Netherlands					
6	3	1	-1	2	3

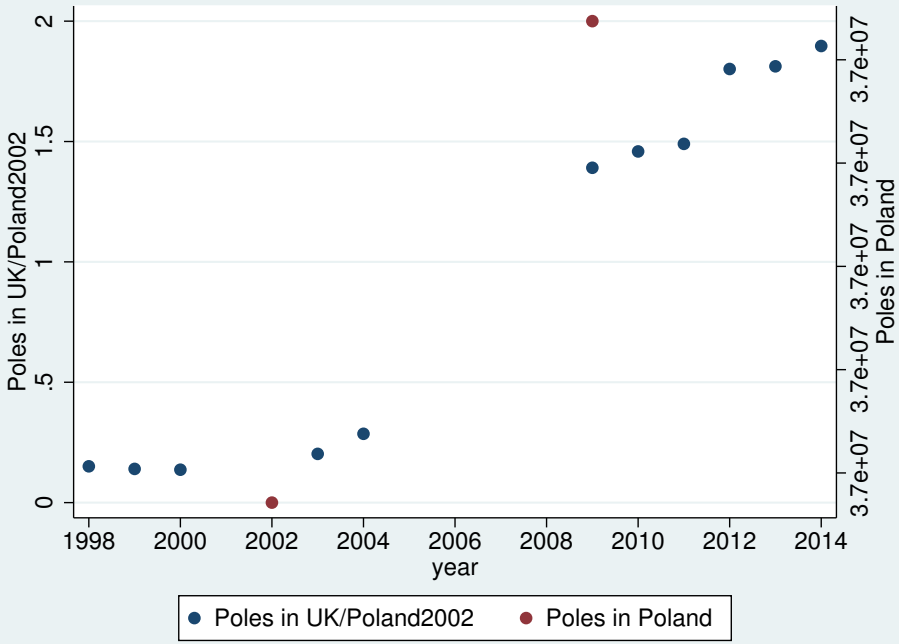
The European Union: Entry and Exit

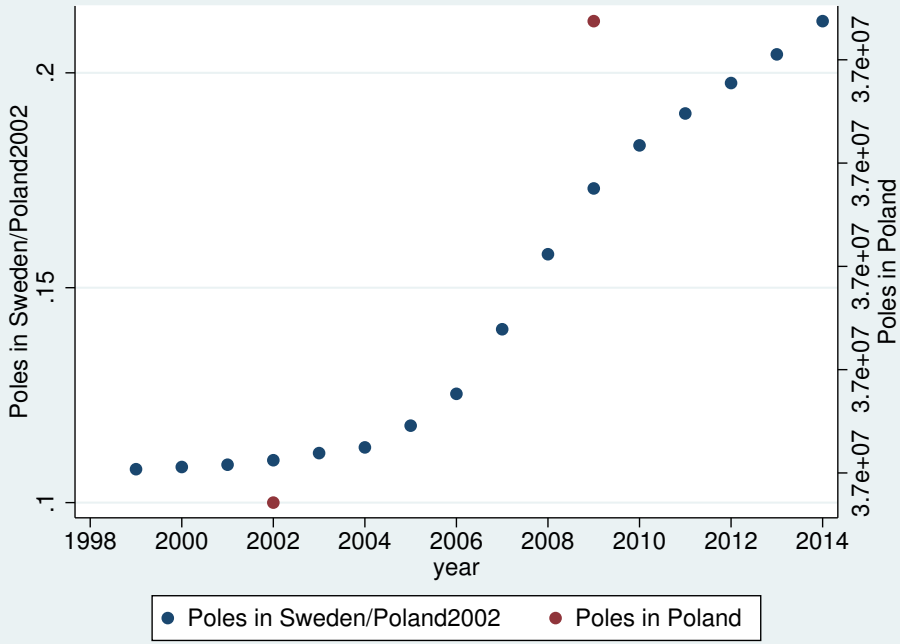
The European Union, $2004 - 2017$			
2004	2007	2013	2017
Poland	Bulgaria	Croatia	~~UK~~[?]
Czech Republic	Romania		
Estonia			
Hungary			
Latvia			
Lithuania			
Slovenia			
Slovakia			
Cyprus			
Malta			
10	2	1	-1

Income Levels

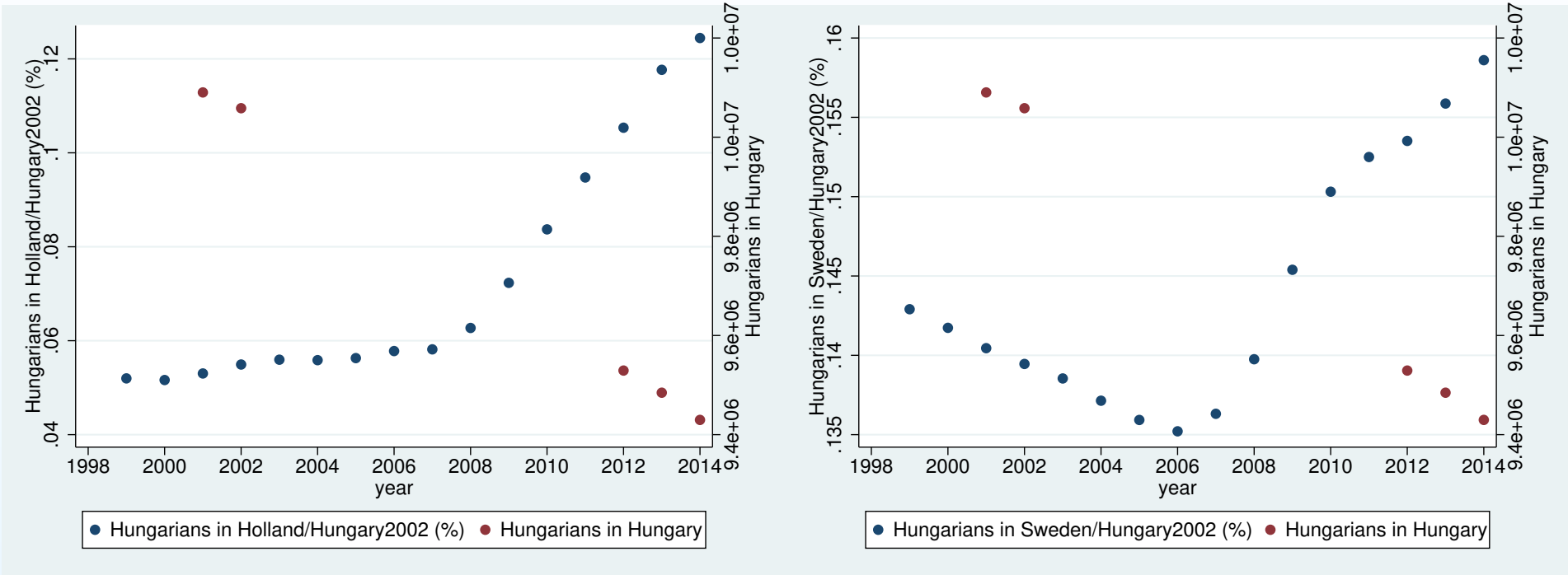


Migration: Poland, UK and Sweden

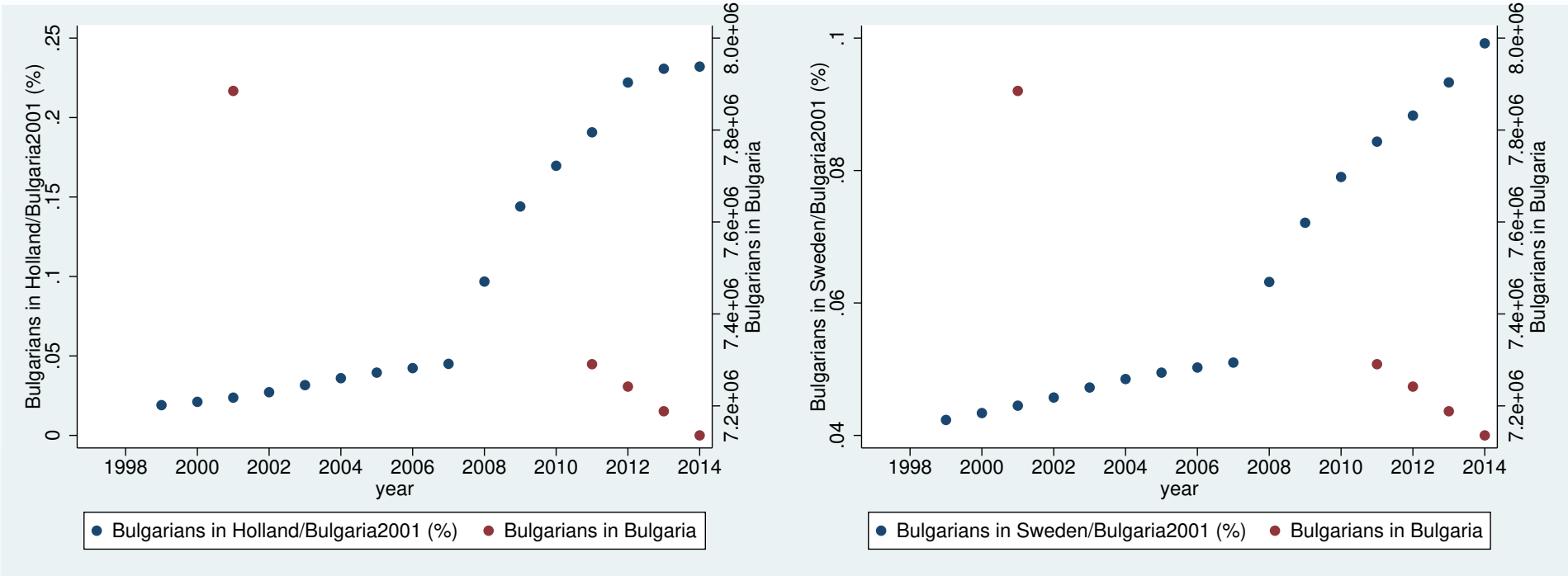




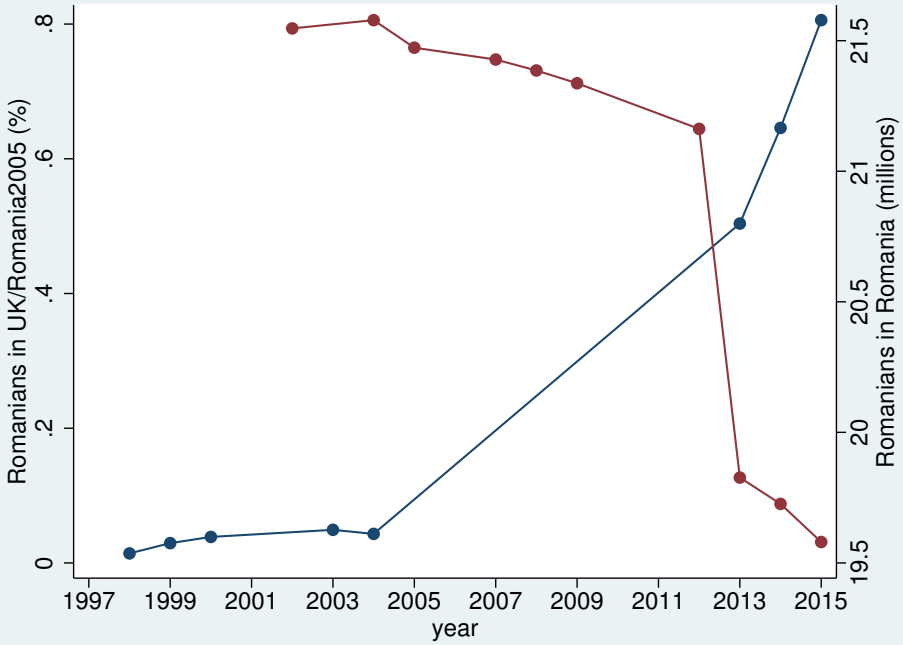
Migration: Hungary, Holland and Sweden

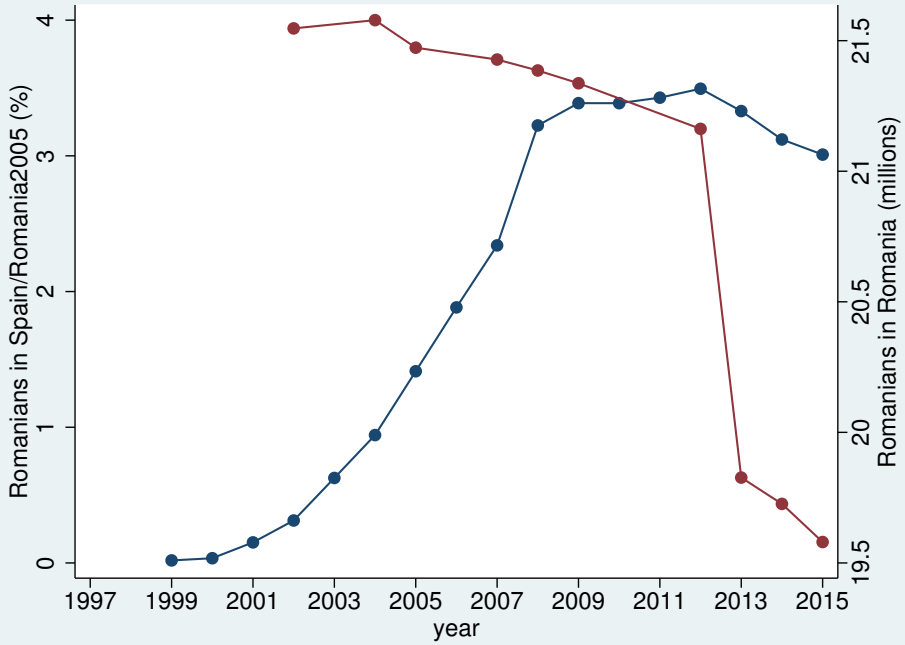


Migration: Bulgaria, Holland and Sweden



Migration: Romania, UK and Spain





General Equilibrium

Given factor prices, goods prices are determined by the cost functions

Given goods prices, quantities are determined by preferences and total income (where income depends on factor prices)

Given goods quantities, and factor prices, producers choose factor quantities

Given factor demands, factor prices are determined by market clearing

Technology

Nested CES

Labor is a composite, a power-linear function of skilled and unskilled labor:

$$L^\kappa = \gamma S^\kappa + (1-\gamma)\, U^\kappa$$

$\zeta = \frac{1}{1-\kappa} \geq 0$: elasticity of substitution between skilled and unskilled labor

$\gamma \in [0,1]$: skill-intensity (relative importance of skilled and unskilled labor)

Output is a power-linear function of capital and (composite) labor.

$$Y^\rho = \alpha K^\rho + (1-\alpha)\, L^\rho$$

$\sigma = \frac{1}{1-\rho} \geq 0$: elasticity of substitution between capital and labor

$\alpha \in [0,1]$: capital-intensity (relative importance of capital and labor)

Alternative nesting: interchange K, U

Technology

It is assumed that the elasticities of substitution are the same for all products, but the factor intensities may differ

No loglinear relationship between factor price and (aggregate) quantity ratios.

Prices

The price of good r is given by

$$p_r^{1-\sigma} = \alpha_r \left(\frac{v}{\alpha_r}\right)^{1-\sigma} + (1-\alpha_r)\left(\frac{W_r}{1-\alpha_r}\right)^{1-\sigma}$$

W_r: price of the labor composite in efficiency units determined by the cost function for labor:

$$W_r^{1-\zeta} = \gamma_r \left(\frac{w^S}{\gamma_r}\right)^{1-\zeta} + (1-\gamma_r)\left(\frac{w^U}{1-\gamma_r}\right)^{1-\zeta}$$

Preferences

Utility function is CES, with inelastic labor supply

$$\mathcal{U}(Q) = \sum_r \theta_r \frac{Q_r^{\varrho} - 1}{\varrho}$$

Elasticity of Substitution in Consumption

$$\beta = \frac{1}{1 - \varrho}$$

expenditure shares

$$\chi_r = \frac{\theta_r^{\beta} p_r^{1-\beta}}{\sum_s \theta_s^{\beta} p_s^{1-\beta}}$$

Cobb-Douglas Preferences $(\beta = 1)$

$$\chi_r = \theta_r$$

Preferences

Quantities determined by the expenditure shares applied to total income

$$p_r Q_r = \chi_r \left(w^S S_0 + w^U U_0 + v K_0 \right)$$

K_0, S_0, U_0: total (world) supplies of capital and labor (efficiency units)

Simple Case: Cobb-Douglas Preferences $(\beta = 1)$

$$p_r Q_r = \theta_r \left(w^S S_0 + w^U U_0 + v K_0 \right)$$

General Equilibrium

Income ratios

$$(x_1, x_2) \quad = \quad \left(\frac{w^S S_0}{v K_0}, \frac{w^U U_0}{v K_0} \right)$$

Share of skilled labor in total labor income (η_r, for each product)

$$\frac{1}{\eta_r} = 1 + \left(\frac{1-\gamma_r}{\gamma_r} \right)^{\zeta} \left(\frac{w^S}{w^U} \right)^{\zeta - 1}$$

Labor share (λ_r, for each product)

$$\frac{1}{\lambda_r} = 1 + \left(\frac{\alpha_r}{1-\alpha_r} \right)^{\sigma} \left(\gamma_r^{\zeta} \left(\frac{w^S}{v} \right)^{1-\zeta} + (1-\gamma_r)^{\zeta} \left(\frac{w^U}{v} \right)^{1-\zeta} \right)^{\frac{\sigma-1}{1-\zeta}}$$

General Equilibrium

Market-clearing equations

$$\begin{aligned}
\sum_r \chi_r \lambda_r \eta_r &= \frac{w^S S_0}{w^S S_0 + w^U U_0 + v K_0} \\
\sum_r \chi_r \lambda_r (1 - \eta_r) &= \frac{w^U U_0}{w^S S_0 + w^U U_0 + v K_0} \\
\sum_r \chi_r (1 - \lambda_r) &= \frac{v K_0}{w^S S_0 + w^U U_0 + v K_0}
\end{aligned}$$

Shares for each product, averaged over products

Compare with values of aggregate factor endowments

General Equilibrium

Two equations

$$\begin{aligned} A_S(x)(1+x_1+x_2) &= x_1 \\ A_U(x)(1+x_1+x_2) &= x_2 \end{aligned}$$

$$x = (x_1, x_2) = \left(\frac{w^S S_0}{vK_0}, \frac{w^U U_0}{vK_0}\right)$$

Aggregate factor shares

$$\begin{aligned} A_S(x) &= \sum_r \chi_r \lambda_r(x) \eta_r(x) \\ A_U(x) &= \sum_r \chi_r \lambda_r(x)(1-\eta_r(x)) \end{aligned}$$

General Equilibrium

Uniqueness

There is a unique equilibrium

Solve two nonlinear equations, two unknowns

This is hard

Proof only for special cases ($\beta = 1$, with $\sigma = 1$ or $\zeta = 1$)

But proof using elementary economic arguments is easy

Uniqueness

1. Any solution of the equations gives a competitive equilibrium.
2. Every competitive equilibrium is Pareto optimal.
3. A Pareto optimum maximizes the utility of an aggregate consumer
   (a) identical homothetic preferences – everyone on the same ray
4. All Pareto optima must have the same total outputs
   (a) strictly convex preferences, convex production set
5. The production function for each good is strictly quasiconcave.
6. All optimal production plans must use the same input vectors.

Immigration and Wages

The effective total supply of labor (aggregated over countries) is

$$\begin{aligned} S_0 &= \sum_j a_{j1} S_j \\ U_0 &= \sum_j a_{j2} U_j \end{aligned}$$

When workers move to a country with higher productivity, effective supply of labor increases, capital labor ratio falls
If M_{jk} workers migrate from j to k,

$$\begin{aligned} \Delta S_0 &= \sum_j \sum_k (a_{k1} - a_{j1}) M_{jk}^S \\ \Delta U_0 &= \sum_j \sum_k (a_{k2} - a_{j2}) M_{jk}^U \end{aligned}$$

Immigration and Real Wages (Cobb-Douglas Case)

Simple Case: Cobb-Douglas Preferences and Technology
$(\beta = \sigma = \zeta = 1)$

$$\begin{aligned} u(q) &= \sum_r \theta_r \log(q_r) \\ \log(q_r) &= \sum_i \alpha_{ir} \log(x_i) \end{aligned}$$

Product Prices (ignoring constants)

$$\log(p_r) = \sum\nolimits_i \alpha_{ir} \log(w_i)$$

Real Wages

$$\begin{aligned} \log(y^*) &= \log y - \sum\nolimits_i \alpha_i \log(w_i) \\ \log(y_k^*) &= \sum\nolimits_i \alpha_i \log(X_i) - \log(X_k) \end{aligned}$$

$\alpha_i = \sum_r \theta_r \alpha_{ir}$

Immigration and Real Wages (Cobb-Douglas Case)

If the unskilled labor endowment doubles, the ratio $\frac{w^U}{v}$ is cut in half,

no change in $\frac{w^S}{v}$

If $\sum_r \theta_r (1-\alpha_r)(1-\gamma_r) = \frac{1}{3}$

e.g labor share is $\frac{2}{3}$ $\left(\alpha_r = \frac{1}{3}\right)$,

and the share of skilled labor in the labor composite is $\gamma_r = \frac{1}{2}$,

then the real wage of skilled workers rises by about 25%

and the real wage of unskilled workers falls by about 40%

Skills and Migration Rates: Puerto Rico

Migration from Puerto Rico to U.S.		
Schooling	**Secondary**	**Post-Secondary**
Wage Ratio	0.52	0.64
Migration Rate	0.40	0.30
ω	0.79	0.82
N	718,559	445,435

Wage (efficiency) ratios vary a lot across finer education levels (from 0.46 for primary education to 0.72 for postgraduate)

World Labor Supply

Effective labor after migration

$$\left(a_j^\omega \times a_j + \left(1 - a_j^\omega\right)\right) \times y_{0s}$$

Increase in effective labor per person

$$\left(1 - a_j^\omega\right)\left(1 - a_j\right)\frac{y_{js}}{a_j}$$

Aggregate increase in effective labor due to migration is

$$\Delta L_0 = \sum_{j=1}^{J}\left(1 - a_j^\omega\right)\left(1 - a_j\right)\frac{y_{js}}{a_j}N_{js}$$

N_{js} is the supply of labor at skill level s in country j.

Efficiency Ratios Estimates

$$a_{js} = \frac{w_{sj}}{w_{s0}}$$

w_{sj}: the wage as skill level s in country j
w_{s0}: wage at the productivity frontier (Germany here)
Data on average wages available for OECD countries
For new EU countries not in OECD
(Bulgaria, Cyprus, Croatia, Lithuania, Malta and Romania)
average wages estimated as income per worker from the Penn World Table
For two skill levels, average wage in country j is

$$\bar{w}_j = (1 - \chi_j)\, w_{1j} + \chi_j \xi_j w_{1j}$$

χ_j: proportion of skilled workers
$\xi_j = \frac{w_{2j}}{w_{1j}}$: relative wage of skilled workers
Estimates of relative wages from de Hoyos, Kennan and Lessem (2016)

$$a_{1j} = \frac{(1 - \chi_0) + \chi_0 \xi_0}{(1 - \chi_j) + \chi_j \xi_j} \frac{\bar{w}_j}{\bar{w}_0}$$

Efficiency Ratios Estimates

Efficiency Ratios													
	bg	cy	cz	ee	hr	hu	lt	lv	mt	pl	ro	sk	si
unskilled	.31	.71	.47	.34	.64	.43	.45	.30	.68	.45	.27	.42	.66
skilled	.38	1.00	.57	.41	.76	.78	.54	.33	.86	.64	.40	.47	.94

Net Gains from Migration

Gross income gains

$$\begin{aligned}\Delta y &= (1 - a_{js})\, y_{0s} \\ &= \frac{1 - a_{js}}{a_{js}} y_{js}\end{aligned}$$

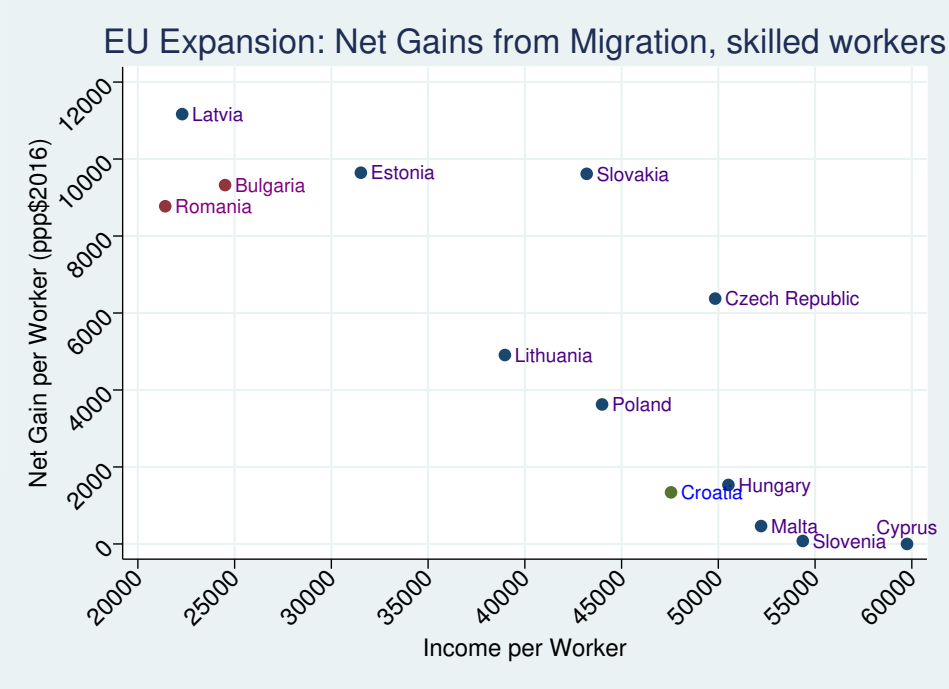
For the average migrant, the net gain is roughly half of this (if the lowest migration cost is zero)

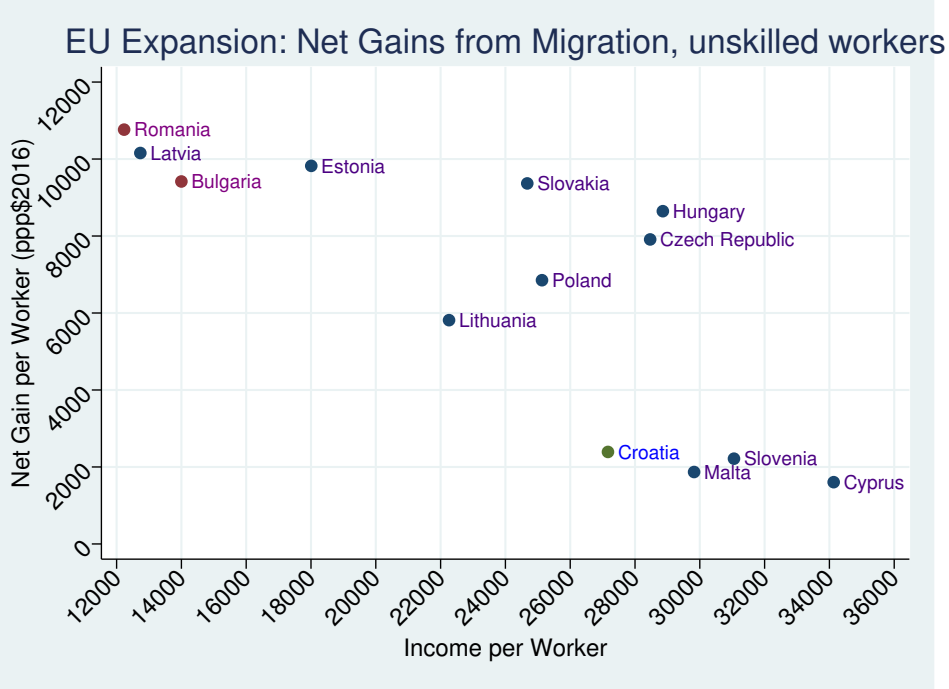
Proportion of people who do not migrate is $a_{js}^{\omega_s}$

Average net income gains (including nonmigrants)

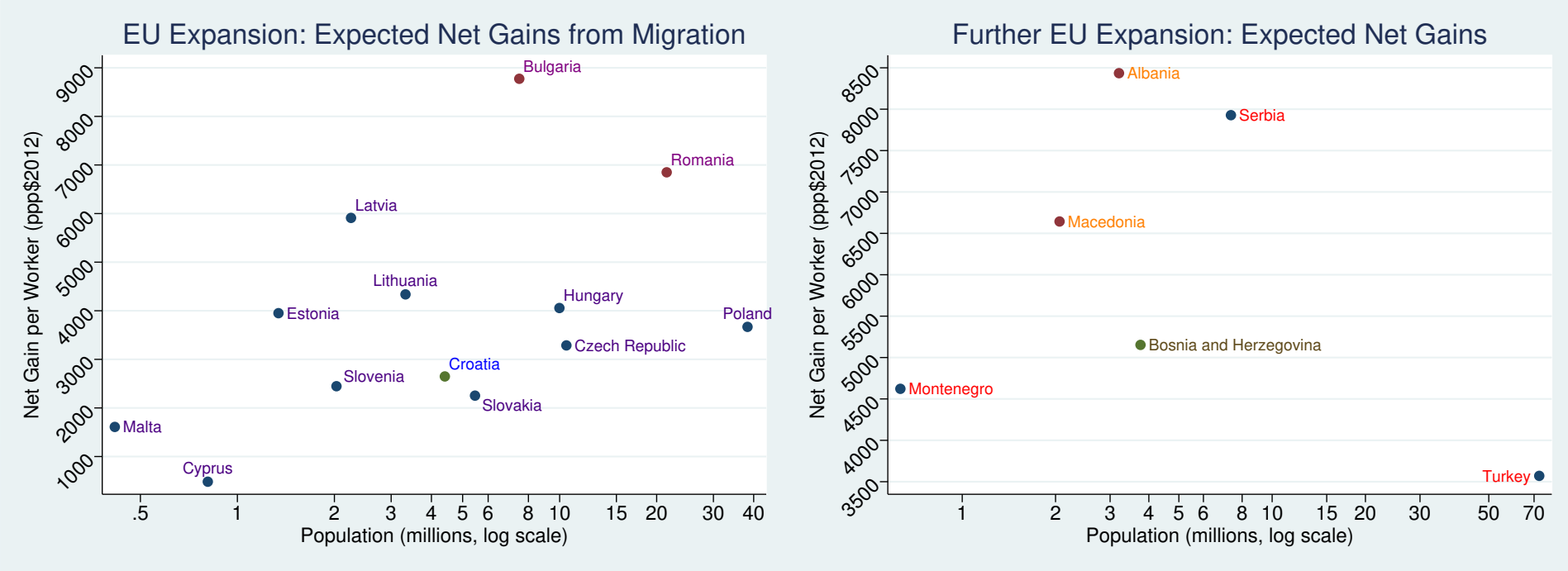
$$\bar{g}_{js} = \frac{1}{2} \frac{\left(1 - a_{js}^{\omega_s}\right)(1 - a_{js})}{a_{js}} y_{js}$$

Net Gains from EU Migration

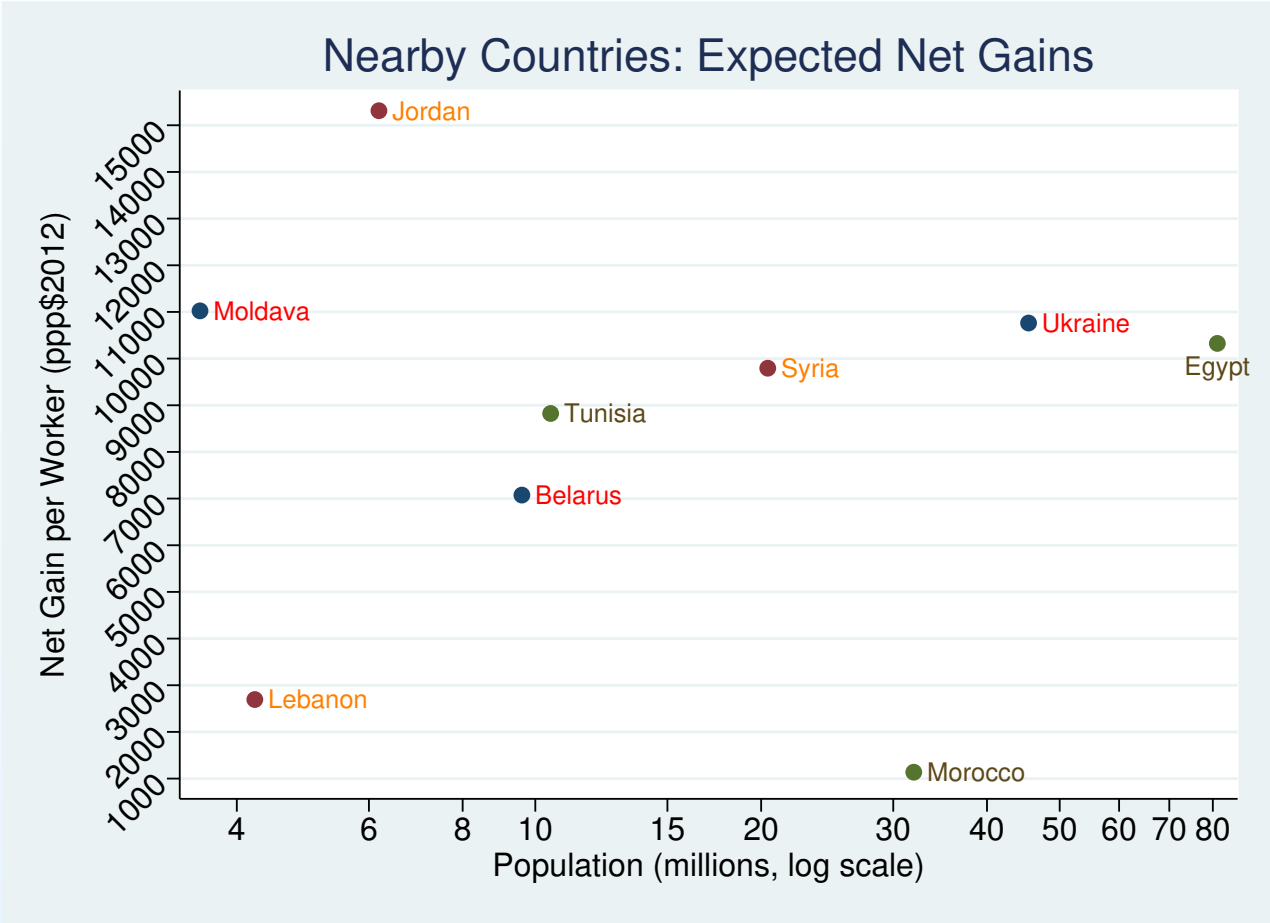




Potential Net Gains from Further Expansion



Potential Net Gains from Further Expansion



Immigration and Real Wage Changes

Cobb-Douglas preferences and technology

$$\begin{aligned} u(q) &= \sum_r \theta_r \log(q_r) \\ q_r &= \sum_i \alpha_{ir} \log(x_{ir}) \end{aligned}$$

Aggregation:

$$\log Q = \sum_i \alpha_i \log(X_i)$$

X_i: endowment of factor i
α_i: weighted factor shares (preference weights):$\alpha_i = \sum_r \theta_r \alpha_{ir}$

Real Wage Changes

$$\Delta \log(w_k) = \sum_{i \neq k} \alpha_i \Delta \log(X_i) - (1 - \alpha_k) \Delta \log(X_k)$$

Immigration and Real Wage Changes

Choose parameter values so that equilibrium relative wages and income shares match the data

Then change labor endowments, and compute the new equilibrium

Real wage change is the equivalent income change:

income that would have yielded the new utility level in the old equilibrium

Factor Shares

Schooling Years	Secondary	Post-Secondary
Workers (Germany)	$44,192$	$41,593$
Wages (Germany)	$2,957$	$4,148$
Shares	43.1%	57.9%
α (capital share =.31)	29.7	39.3%

Immigration and Real Wage Changes

Real Wage Changes: EU Expansion		
Schooling	**Secondary**	**Post-Secondary**
Immigration (millions)	16.63	4.13
Percentage Increase in Effective Labor	14.8%	6.7%
Real Wage Change	-6.8%	$+0.2\%$
Employment in EU15 (millions)	112.3	61.2
Employment in EU+13 Countries	32.4	11.0

Substitution Elasticities and Real Wage Changes

(Cobb-Douglas Preferences)

		Schooling Years	
		Secondary	**Post-Secondary**
	Effective Labor Change		
		14.8%	6.7%
	ζ	Real Wage Changes	
$\sigma = \frac{1}{2}$	$\frac{1}{2}$	-12.4%	1.3%
	1	-9.5%	-2.7%
	2	-8.1%	-4.7%
	$\frac{1}{2}$	-9.3%	5.0%
$\sigma = 1$	1	-6.3%	0.8%
	2	-4.8%	-1.2%
	$\frac{1}{2}$	-7.7%	6.7%
$\sigma = 2$	1	-4.7%	2.5%
	2	-3.1%	0.5%

Long-Run Wage Effects

Migration increases the return on capital

Steady State

$$f'(k^*) = \rho + \delta$$

f': marginal product of capital

ρ: rate of time preference

δ: depreciation rate of capital

k^* :effective capital-labor ratio

Migration increases effective labor

Capital-labor ratio falls below k^*, MPK rises above $\rho + \delta$

Investment increases, effective capital-labor ratio returns to k^*

Real wage returns to original level

Long-Run Human Capital Effects

Migration increases the return to skill
(partly by decreasing the real wages of unskilled workers)
Next step:
consider long run effects when physical and human capital are both chosen optimally

Conclusion

The welfare cost of immigration restrictions is very high

Real wage effects of open borders in the EU are surprisingly small

- unskilled real wage falls by less than 12% (everywhere) in the short run
- and migration is a slow process
- meanwhile investment restores the real wage

Migration changes proportions of skilled and unskilled workers

- efficiency ratios may be different, affecting migration rates
- skilled workers have lower migration costs
- but there are many more unskilled workers

Big incentives to invest in capital

- Big incentives to invest in human capital

Other Questions

- What happens with general substitution elasticities in consumption and production?
- Allow for alternative CES nesting structures

Skills and Migration Rates: Puerto Rico

Schooling	0-9	9-11	12	13-15	16	17
Wage Ratio	0.46	0.49	0.53	0.60	0.67	0.72
Stay	0.68	0.53	0.62	0.69	0.73	0.64
ς	0.49	0.88	0.75	0.72	0.78	1.34
N	218,715	203,138	515,421	254,483	134,023	56,929

Wage (efficiency) ratios vary a lot across education levels

Effective Labor Supply

Results

Increase in World Labor Supply		
Schooling Years	**0-12**	**13-16**
Percentage Increase in Effective Labor	126%	39%
Migration from Non-Frontier Countries (millions)	$1,665$	194
Population in Frontier Countries (age 20-64)	408	258
Population in Non-Frontier Countries (age 20-64)	$2,571$	329
Migration from Non-Frontier EU Countries (millions)	22	6
Population in Non-Frontier EU Countries (age 20-64)	51	13

Frontier country: real GDP per worker above $\$46,460$ in 2010 [Portugal]

- a big increase in labor supply
- a big decrease in the ratio of skilled to unskilled workers
- huge population movements
- (but movement is slow)

Immigration and Real Wage Changes

Substitution Elasticities and Real Wage Changes:Extreme Cases

		Schooling Years	
		0-12	**13-16**
		Effective Labor Change	
		112%	28%
$\sigma = \frac{1}{10}$	ζ		
	$\frac{1}{10}$	-99.7%	-82.7%
	1	-97.2%	-95.7%
	10	-97.0%	-96.9%
$\sigma = 1$	$\frac{1}{10}$	-97.3%	54.4%
	1	-32.5%	1.2%
	10	-16.4%	-12.9%
$\sigma = 10$	$\frac{1}{10}$	-97.0%	71.3%
	1	-22.6%	16.1%
	10	-3.5%	0.5%

Real Wage Changes: Consumer Substitution

Three goods, each produced by a single factor
(effectively an endowment economy)
CES preferences over goods, substitution elasticity β

	Schooling Years	
	0-12	**13-16**
Effective Labor Change		
	+112%	+28%
β		
$\frac{1}{2}$	-57.5%	-4.3%
1	-32.5%	+1.2%
2	-17.1%	1.5%

Surprise:
results for $\beta = E$ are exactly the same as results for $\sigma = \zeta = E$ with $\beta = 1$