Engel's Law in the Global Economy: Demand-Induced Patterns of Structural Change, Innovation, and Trade

Kiminori Matsuyama
Northwestern University

July 12, 2017

International Trade and Investment
NBER Summer Institute

Introduction

Motivation

- *Endogenous Demand Composition due to Nonhomothetic Demand* (Engel's Law)

✓ Expenditure shares more skewed towards higher income elastics in richer countries.

✓ An important channel through which economic growth and globalization affect

  i) Sectoral compositions in employment and in value-added
  ii) Variations in innovation/productivity growth rates across sectors (Schmookler)
  iii) Patterns of intersectoral trade between rich and poor countries (Linder)
  iv) Migration of industries from rich to poor countries (Vernon's Product Cycles)

- These effects are *interconnected*, yet studied *separately*, which can be *misleading*.

✓ *False* dichotomy of income elasticity vs. productivity growth differences

  - *Endogenous* productivity response to the relative market size

✓ *Alleged* claim that globalization *reduces* the power of domestic demand composition

  - Gains from trade have *the income effect*
  - The Linder Effect *magnifies* the power of domestic demand composition
  - Migration of industries from the rich to the poor *facilitate* structural change in both

- By capturing all these interactive effects of Engel's Law, we offer a *unifying* perspective on how economic growth and globalization affect patterns of structural change, innovation, and trade.

Framework: 2-country directed technical change with endogenous demand compositions

- One Nontradeable Factor (labor)

- **2 Countries**; differ only in *population size* (N) and *labor productivity* (h), hence also in the country size, measured in *effective labor supply* ($L = hN$)

- **Continuum of Nontradeable Consumption Goods**, $s \in I$, with preferences given by *Implicitly (Directly and Indirectly) Additive Isoelastic Nonhomothetic CES*
  - o Goods-specific income elasticity parameters, $\varepsilon(s)$, increasing in $s \in I$
  - o Constant elasticity of substitution parameter, η, *not* linked to income elasticity parameters, $\varepsilon(s)$; Goods can be complements ($\eta < 1$) or substitutes ($\eta > 1$).

- Production side deliberately standard, *a la* Dixit-Stiglitz-Krugman
  - o Each nontradeable consumption good produced in a competitive sector by assembling tradeable differentiated inputs with *CES aggregators*.
  - o **Tradeable differentiated intermediate inputs**:
    - ✓ supplied by *monopolistic competitive* firms with labor for both production and entry
    - ✓ subject to *iceberg trade cost*
  - o **Endogenous Sectoral TFP**, depend on the availability of differentiated inputs in each sector, endogenous through entry and trade.

Implicit (Direct or Indirect) Additivity: Hanoch (1975)

Exp. Dir. Additive: $u = M\left[\int_I f_s(c_s)ds\right]$; Exp. Indir. Additive; $u = M\left[\int_I v_s(p_s)ds\right]$

Explicit CES, $u = \left[\int_I \omega_s (c_s)^{1-1/\eta} ds\right]^{\eta/(\eta-1)}$; both explicitly directly & indirectly additive.

Explicit additivity, either direct or indirect, imposes functional relation between income and price elasticities. (e.g., Pigou's Law under direct explicit additivity)

i) Empirically false (Deaton 1974 and others)

ii) Conceptually impossible to disentangle the effects of income elasticity differences from those of price elasticity differences

iii) Non-Homotheticity ↔ Non-CES, a nuisance for our purpose.

Imp. Dir. Additive: $M\left[\int_I f_s(u, c_s)ds\right] = 1$; Imp. Indir. Additive: $M\left[\int_I v_s(p_s, V)ds\right] = 1$

Implicit CES, $\left[\int_I \omega_s(u)(c_s)^{1-1/\eta} ds\right]^{\eta/(\eta-1)} = 1$; both directly & indirectly implicitly additive.

i) Allow for sector-specific income elasticities, *unrelated* to the price elasticities

ii) If $\partial \log \omega_s(u)/\partial u$ varies with *s*, ***nonhomothetic*** *CES*

iii) If $\partial \log \omega_s(u)/\partial u$ increasing in *s*, $\omega_s(u)$ is ***log-supermodular***

iv) If $\omega_s(u)$ ***isoelastic*** *in u*, $\partial \log \omega_s(u)/\partial \log u$ depends on *s* but not on *u*, consistent with the evidence for the stable slope of the Engel curve.

v) We also focus on $\eta < 1$, as the evidence suggests.

Main Results in a Closed Economy

- Sectoral shares in employment (also valued-added) = Sectoral shares in expenditure

- A higher *h* or *N* leads to

✓ A higher welfare or standard-of-living, measured in per capita real income
✓ Sectoral shares in expenditure and employment shift toward higher-s in the sense of ***Monotone Likelihood Ratio*** (MLR)
✓ Productivity growth faster in higher-s through entry and exit (Schmookler effect)
✓ Relative prices changes would moderate (amplify) sectoral shifts when consumptions goods are complements (substitutes)

Note: With the Schmookler effect, the usual dichotomy of income elasticity vs. productivity growth differences in the structural change literature would be false.

- Per capita real income would be lower in a country with higher *h* if it is sufficiently smaller in $L = hN$

Main Results in a Trade Equilibrium: Cross-Country Variations

- *Endogenous Terms of Trade* The wage rate lower in the country smaller in $L = hN$
- *Endogenous Country Ranking*. The country higher in h but smaller in $L = hN$ may be poorer at a high trade cost but richer at a low enough trade cost.
- *Demand Composition Differences:* Expenditure shares more skewed towards higher-income elastic sectors in the richer country.

Employment (or value-added) shares ≠ expenditure shares. One may think trade would make endogenous demand composition *less* important. On the contrary,

- Trade ***amplifies*** the effects of demand composition differences via *Home Market Effect (HME)*
  - ✓ *Employment;* Rich's labor employment more skewed towards higher-income elastic than Poor's, and ***even more so than the expenditure share***.
  - ✓ *Patterns of Trade (The Linder Effect);* a cut-off sector, $s_c \in I$, below (above) which Poor (Rich) is a net-exporter, ***regardless of the relative country size.***

Note: HME due to the cross-country difference in the demand composition across sectors, not due to the cross-country difference in the demand size in each sector

Main Results in a Trade Equilibrium: Comparative Statics

- **A uniform increase in *h* (*or N*)**
  - ✓ *No effect on ToT nor on Country Ranking*
  - ✓ *Structural Change:* Expenditure and employment shares shift towards higher-income elastic in both countries
  - ✓ *Product cycles:* a cut-off sector, $s_c \in I$, goes up, turning the richer country from a net-exporter to a net-importer in the middle.
  - ✓ *Welfare gaps to narrow (widen)* if sectors produce complements (substitutes)

- **A (uniform) decline in iceberg trade cost** (when the countries equal in $L = hN$)
  - ✓ Isomorphic to a uniform increase in *h.*

  Under Engel's Law, globalization, through its productivity effect, causes structural change and product cycles.

- **A (uniform) decline in iceberg trade cost** (when the countries differ in $L = hN$).
  - ✓ *ToT change in favor of the smaller country → Factor Price Convergence*
  - ✓ *Leapfrogging:* The country higher in *h* but smaller in *L* may be poorer is a less globalized world, becomes richer with globalization
  - ✓ *Reversal of the patterns of trade*

The Framework

One Nontradeable Factor (Labor)

Two Countries (j or k = 1 or 2): populated by N^j identical agents each endowed with h^j units of effective labor, inelasticaly supplied at w^j.

- N^j(the population size) & h^j (labor productivity or human capital) are the only possible sources of heterogeneity across the two countries.
- $w^k h^k = E^k$; Per capita "Nominal" Income (and Expenditure) in k,
- $L^j = h^j N^j$; Total Effective Labor Supply in j:

Continuum of Nontradeable Consumption Goods, $s \in I \subset R$ with preferences:

$$\tilde{U}^k = U\left(C_s^k, s \in I\right), \textit{ implicitly additive as } \left[\int_I (\beta_s)^{\frac{1}{\eta}} \left(\tilde{U}^k\right)^{\frac{\varepsilon(s)-\eta}{\eta}} \left(C_s^k\right)^{\frac{\eta-1}{\eta}} ds\right]^{\frac{\eta}{\eta-1}} \equiv 1$$

- $I = (0,1)$ and $\int_I \varepsilon(s) ds = 1$ without loss of generality
- $(\varepsilon(s)-\eta)/(1-\eta) > 0$ for global monotonicity & quasi-concavity
- If $\varepsilon(s) = 1$ for all $s \in I$, standard homothetic CES
- If $\varepsilon(s) \neq 1$, *nonhomothetic.* No longer explicitly additive
- Index sectors so $\varepsilon(s)$ *increasing* in $s \in I$ → $\omega\left(s, \tilde{U}^k\right) \equiv (\beta_s)^{\frac{1}{\eta}} \left(\tilde{U}^k\right)^{\frac{\varepsilon(s)-\eta}{\eta}}$ is *log-supermodular* in s & $\tilde{U}^k$ (The happier agents put more weights on the higher-indexed.)

Utility Maximization: Given P_s^k, $s \in I$ and E^k, choose C_s^k, $s \in I$ and $\tilde{U}^k$ to

$$U^k = \text{Max } \tilde{U}^k, \text{ s.t. } \left[\int_I (\beta_s)^{\frac{1}{\eta}} \left(\tilde{U}^k\right)^{\frac{\varepsilon(s)-\eta}{\eta}} \left(C_s^k\right)^{\frac{\eta-1}{\eta}} ds\right]^{\frac{\eta}{\eta-1}} \equiv 1 \text{ and } \int_I P_s^k C_s^k ds \leq E^k$$

Properties of the Consumption Demand System:

Expenditure Shares: $m_s^k \equiv \frac{P_s^k C_s^k}{E^k} = \frac{\beta_s (U^k)^{\varepsilon(s)-\eta} (P_s^k)^{1-\eta}}{(E^k)^{1-\eta}} = \frac{\beta_s (U^k)^{\varepsilon(s)-\eta} (P_s^k)^{1-\eta}}{\int_I \beta_t (U^k)^{\varepsilon(t)-\eta} (P_t^k)^{1-\eta} dt}$

Indirect Utility Function: Implicitly additive (Not explicitly additive with $\varepsilon(s) \neq 1$)

$$\left[\int_I \beta_s (U^k)^{\varepsilon(s)-\eta} (P_s^k / E^k)^{1-\eta} ds\right]^{\frac{1}{\eta-1}} = E \Big/ \left[\int_I \beta_s (U^k)^{\varepsilon(s)-\eta} (P_s^k)^{1-\eta} ds\right]^{\frac{1}{1-\eta}} = 1$$

(Per capita) Real Income:

$U^k = \frac{E^k}{P^k}$, where $P^k \equiv \left[\int_I \beta_s (U^k)^{\varepsilon(s)-1} (P_s^k)^{1-\eta} ds\right]^{\frac{1}{1-\eta}}$ is the *exact price index.*

Double-Log Demand System:

$$\log(m_s^k / m_{s'}^k) = \log(\beta_s / \beta_{s'}) + (\varepsilon(s) - \varepsilon(s'))\log(U^k) + (1-\eta)\log(P_s^k / P_{s'}^k)$$

✓ Higher-indexed more income elastic

✓ Price elasticity is *not* linked to sector-specific income elasticity

✓ Empirically, common (unitary) income elasticity as well as the positive correlation between income and price elasticities implied by Pigou's Law, are rejected, but not common price elasticity.

Rest of the model: Standard Dixit-Stiglitz-Krugman-(Ethier-Romer)

Competitive Nontradeable Consumption Goods Sectors, $s \in I$, produce $Y_s^j = N^j C_s^j$

by combining tradable intermediate inputs, $\nu \in \Omega_s$, with CES aggregators,

$$Y_s^j \equiv \left[\int_{\Omega_s} \left(q_s^j(\nu) \right)^{1-\frac{1}{\sigma}} d\nu \right]^{\frac{\sigma}{\sigma-1}}, \; s \in I; \;\; \sigma > \text{Max}\{1, \eta\}$$

Cost Minimization: given $p_s^j(\nu)$, the unit price of input variety $\nu \in \Omega_s$ in *j*,

$$q_s^j(\nu) = \left(\frac{p_s^j(\nu)}{P_s^j} \right)^{-\sigma} Y_s^j = \frac{\left(p_s^j(\nu) \right)^{-\sigma}}{\left(P_s^j \right)^{1-\sigma}} N^j m_s^j E^j, \quad \text{where } \left(P_s^j \right)^{1-\sigma} \equiv \int_{\Omega_s} \left(p_s^j(\nu) \right)^{1-\sigma} d\nu$$

Monopolistically Competitive Tradeable Differentiated Inputs Producers $s \in I$

$\Omega_s = \Omega_s^1 + \Omega_s^2$; Ω_s^j disjoint sets of input varieties produced in j = 1, 2

ϕ_s (in labor) to set up each variety;

ψ_s (in labor) to produce a unit of each variety

Iceberg Trade Costs: Only $1/\tau < 1$ of exports survives shipping, raising the export price by $\tau > 1$, reducing the export demand by $(\tau)^{-\sigma} < 1$ and the export revenue by $\rho \equiv (\tau)^{1-\sigma} < 1$

World Demand for Each Input Variety; $D_s(\nu) = A_s^j (p_s^j(\nu))^{-\sigma}$, $\nu \in \Omega_s^j$, where

$$A_s^1 \equiv b_s^1 + \rho b_s^2,\ A_s^2 \equiv \rho b_s^1 + b_s^2,\ \text{where } b_s^j \equiv \beta_s \left(E^j\right)^{\eta} \left(U^j\right)^{\varepsilon(s)-\eta} N^j \left(P_s^j\right)^{\sigma-\eta}$$

Standard CES demand curve, but U^1 and U^2 affects A_s^j differently across j and s.

Pricing: $p_s^j(\nu) = \dfrac{w^j \psi_s}{1-\sigma^{-1}} \equiv p_s^j < \tau p_s^j = p_s^k(\nu)$ for $\nu \in \Omega_s^j$ and $j \neq k$

Zero Profit: $A_s^j (p_s^j)^{-\sigma} \equiv y_s^j = (\sigma - 1)\phi_s / \psi_s$ for $s \in I$

Labor Demand: $L_s^j = \left(\phi_s + \psi_s y_s^j\right) V_s^j = \sigma \phi_s V_s^j$ for $s \in I$

V_s^j : the measure of Ω_s^j, proportional to labor employment

Labor Market Equilibrium: $\int_I L_s^j ds = L^j$ or $\int_I f_s^j ds = 1$,

$f_s^j \equiv L_s^j / L^j$: sector-s's share in employment (& in value-added) in j.

Patterns of Structural Change in a Closed Economy

Define $u(\bullet)$ by $(x)^{\left(\frac{1-\eta}{\sigma-\eta}\right)} \equiv \int_I \left(\beta_s (u(x))^{(\varepsilon(s)-\eta)}\right)^{\left(\frac{\sigma-1}{\sigma-\eta}\right)} ds$.

Per capita real income: $U_0^j = u(x_0^j)$, where $x_0^j \equiv (h^j)^\sigma N^j = (h^j)^{\sigma-1} L^j$

- $U_0^j = u(x_0^j)$ increasing in x_0^j (hence both in h^j & N^j). Aggregate increasing returns
- A higher h^j has a larger effect than a higher N^j.
- $h^1 > h^2$ and $U_0^1 < U_0^2$ holds if $L^1 / L^2 < (h^1 / h^2)^{1-\sigma} < 1$.

The smaller country could be poorer in spite of higher labor productivity

Market Size Distributions: $m_s^j = \dfrac{\left(\beta_s (u(x_0^j))^{(\varepsilon(s)-\eta)}\right)^{\frac{\sigma-1}{\sigma-\eta}}}{\int_I \left(\beta_t (u(x_0^j))^{(\varepsilon(t)-\eta)}\right)^{\frac{\sigma-1}{\sigma-\eta}} dt}$

- Labor is allocated proportionately with market sizes; $f_s^j = m_s^j$,
- Sectoral TFP, $w^j / P_s^j = (L^j f_s^j)^{\frac{1}{\sigma-1}}$, due to the Dixit-Stiglitz variety effect in each sector
- ω is indeterminate.

Comparative Statics: An increase in $x_0^j \equiv (h^j)^\sigma N^j \uparrow$

- Higher per capita real income, $U_0^j = u(x_0^j) \uparrow$
- They spend relatively more on higher-indexed goods (in the sense of MLR).
- This causes entries (exits) in the higher(lower)-indexed sectors.
- The employment shares shift toward the higher-indexed (in the sense of MLR).
- Productivity grows faster in higher-indexed sectors, which moderates (amplifies) the sectoral shift if the consumption goods are complements (substitutes).

Formally, as $\eta < (>) 1$,

$$\left|\frac{d\log(m_s^j / m_{s'}^j)}{d\log\left(u(x_0^j)\right)}\right| = \left(\frac{\sigma-1}{\sigma-\eta}\right)\left|\varepsilon(s)-\varepsilon(s')\right| < (>) \left|\frac{\partial\log(m_s^j / m_{s'}^j)}{\partial\log\left(u(x_0^j)\right)}\right| = \left|\varepsilon(s)-\varepsilon(s')\right|,$$

because

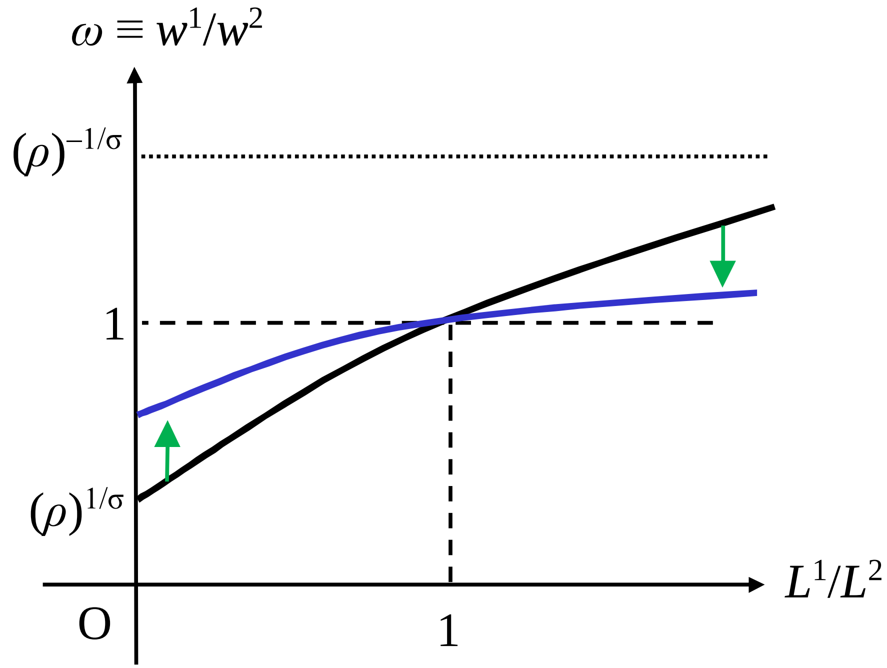
$$\frac{d\log(m_s^j / m_{s'}^j)}{d\log\left(u(x_0^j)\right)} = \frac{\partial\log(m_s^j / m_{s'}^j)}{\partial\log(u(x_0^j))} + (1-\eta)\frac{\partial\log(P_s^j / P_{s'}^j)}{\partial\log\left(f_s^j / f_{s'}^j\right)} \frac{d\log(f_s^j / f_{s'}^j)}{d\log\left(u(x_0^j)\right)}$$

Total Effect = Direct Income Effect + Indirect Substitution Effect
(caused by induced productivity change)

and from $P_s^j / P_{s'}^j = \left(f_s^j / f_{s'}^j\right)^{\frac{1}{1-\sigma}} = \left(m_s^j / m_{s'}^j\right)^{\frac{1}{1-\sigma}}$.

Trade Equilibrium: Cross-Country Variations

Figure 1: Equilibrium (Factor) Terms of Trade: $\frac{L^1}{L^2} = (\omega)^{2\sigma-1} \frac{1-\rho(\omega)^{-\sigma}}{1-\rho(\omega)^{\sigma}} > 0$



The factor price lower in the smaller economy (Aggregate increasing returns)

Globalization (τ ↓ or ρ ↑) reduces the smaller country's disadvantage and hence the factor price differences.

Per capita real income: $U_\rho^k = u\left(x_\rho^k\right)$, with $x_\rho^1 \equiv \dfrac{(1-\rho^2)x_0^1}{1-\rho(\omega)^{-\sigma}} > x_0^1$; $x_\rho^2 \equiv \dfrac{(1-\rho^2)x_0^2}{1-\rho(\omega)^{\sigma}} > x_0^2$

$u(x)$, defined as before. **Gains from trade**

Market Size Distributions: $m_s^j = \dfrac{\left(\beta_s\left(u(x_\rho^j)\right)^{(\varepsilon(s)-\eta)}\right)^{\frac{\sigma-1}{\sigma-\eta}}}{\left(x_\rho^j\right)^{\left(\frac{1-\eta}{\sigma-\eta}\right)}} = \dfrac{\left(\beta_s\left(u(x_\rho^j)\right)^{(\varepsilon(s)-\eta)}\right)^{\frac{\sigma-1}{\sigma-\eta}}}{\int_I\left(\beta_t\left(u(x_\rho^j)\right)^{(\varepsilon(t)-\eta)}\right)^{\frac{\sigma-1}{\sigma-\eta}}dt}$

If $u\left(x_\rho^1\right) < u\left(x_\rho^2\right)$

MLR: $\dfrac{m_s^1}{m_s^2} = \left(\dfrac{x_\rho^1}{x_\rho^2}\right)^{\left(\frac{\eta-1}{\sigma-\eta}\right)}\left(\dfrac{u(x_\rho^1)}{u(x_\rho^2)}\right)^{(\varepsilon(s)-\eta)\left(\frac{\sigma-1}{\sigma-\eta}\right)}$ is strictly decreasing in *s:*

The Rich (Poor)'s expenditure is more skewed towards higher(lower)-indexed sectors.

Home Market Effect in Employment

$$\frac{f_s^1}{f_s^2} \text{ is increasing in } \frac{m_s^1}{m_s^2}, \ \frac{f_s^1}{f_s^2} > \frac{m_s^1}{m_s^2} > 1; \ \frac{f_s^1}{f_s^2} = \frac{m_s^1}{m_s^2} = 1; \text{ or } \ \frac{f_s^1}{f_s^2} < \frac{m_s^1}{m_s^2} < 1.$$

Disproportionately large shares of labor are employed in the sectors, in which the country spend larger shares of its expenditure relatively to the ROW.

If $U_\rho^1 < U_\rho^2$ → m_s^1 / m_s^2 is strictly decreasing in s → a **unique cutoff sector,** $s_c \in I$, with

$$\frac{f_s^1}{f_s^2} > \frac{m_s^1}{m_s^2} > 1 \quad \text{for } s < s_c; \quad \text{and} \qquad \frac{f_s^1}{f_s^2} < \frac{m_s^1}{m_s^2} < 1 \quad \text{for } s > s_c.$$

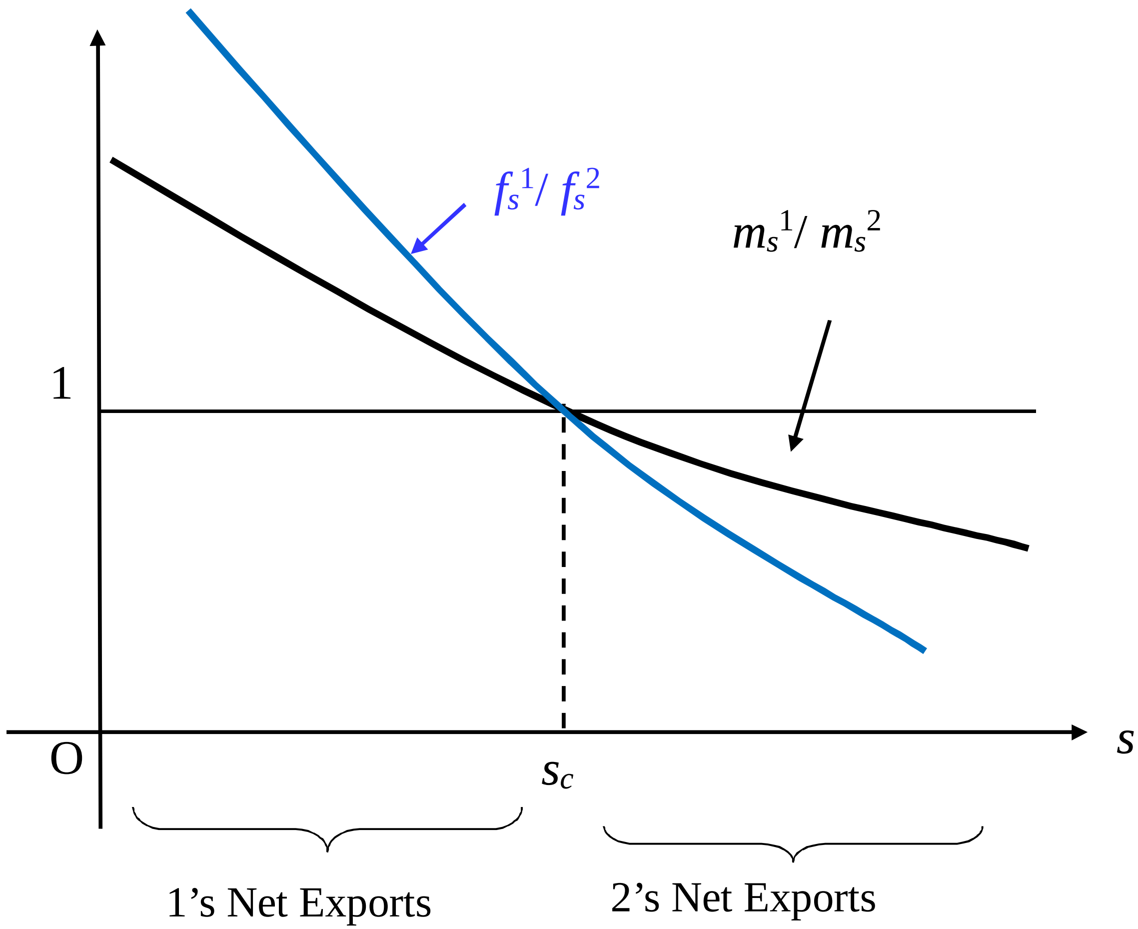
Home Market Effect in the Intersectoral Patterns of Intrasectoral Trade:

$$NX_s^1 = -NX_s^2 > 0 \text{ for } s < s_c; \quad NX_s^1 = -NX_s^2 < 0 \quad \text{for } s > s_c.$$

Note: Patterns of trade due to the cross-country difference in *the domestic market size distribution across sectors*, *not in the domestic market size in each sector*

Figure 2: HME in Employment and Patterns of Trade:

For $U_{\rho}^{1} = u(x_{\rho}^{1}) < U_{\rho}^{2} = u(x_{\rho}^{2})$



The Richer runs surpluses in higher income elastic sectors, even if it is a lot smaller so that its market size in those sectors may be smaller compared to the Poorer but bigger.

Ranking the Countries: Trade-off between Labor Productivity & Country Size:
Smaller country with *higher h* can be poorer at a low ρ but is richer at high ρ

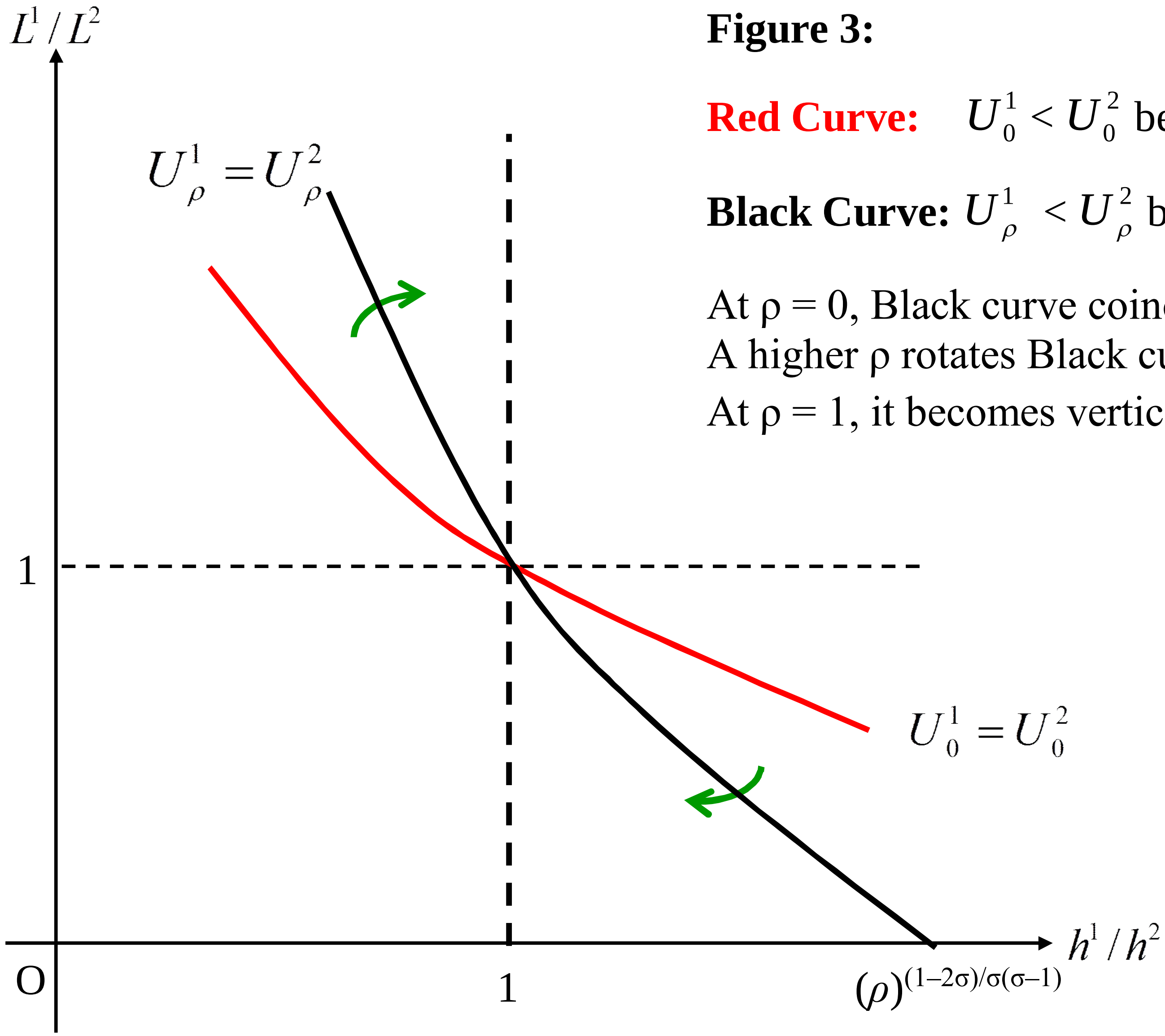


Figure 3:

Red Curve: $U_0^1 < U_0^2$ below, $U_0^1 > U_0^2$ above

Black Curve: $U_\rho^1 < U_\rho^2$ below, $U_\rho^1 > U_\rho^2$ above

At ρ = 0, Black curve coincides with Red curve.
A higher ρ rotates Black curve clockwise,
At ρ = 1, it becomes vertical at $h^1/h^2 = 1$

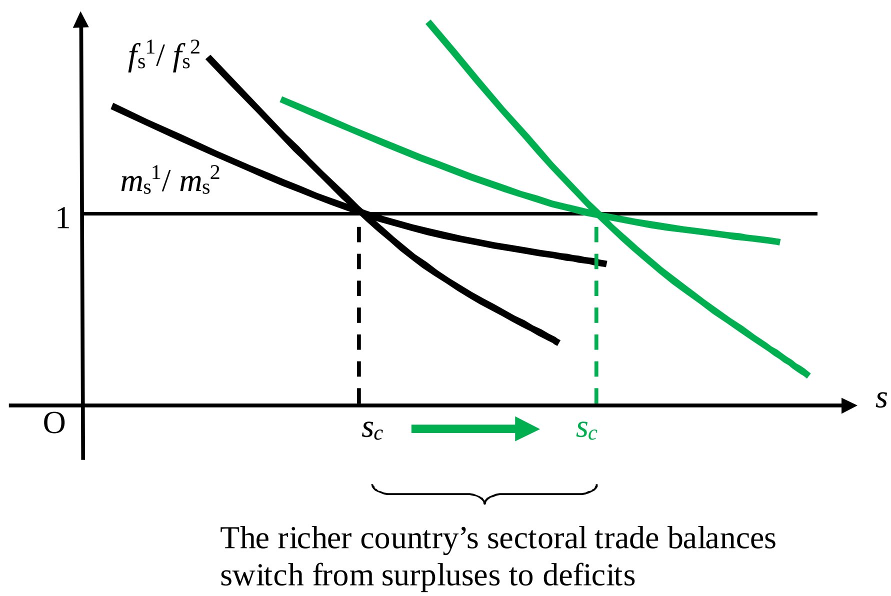
Trade Equilibrium: Comparative Statics

Uniform Labor Productivity Growth: $(\partial \log(h^1) = \partial \log(h^2) \equiv \partial \log(h) > 0)$

h^1/h^2, L^1/L^2, $\omega = w^1/w^2$, x_0^1/x_0^2, x_ρ^1/x_ρ^2 all unchanged, with $\partial \log(x_\rho^1) = \partial \log(x_\rho^2) = \sigma\partial \log(h) > 0$.

- Both $U_\rho^1 = u(x_\rho^1)$ *and* $U_\rho^2 = u(x_\rho^2)$ go up.
- Demand compositions shift toward higher-indexed in both countries (MLR)
- s_c goes up.
- Welfare gaps widen (narrow) if sectors produce substitutes (complements).

Figure 4: Uniform Labor Productivity Growth: Patterns of Structural Change and Product Cycles



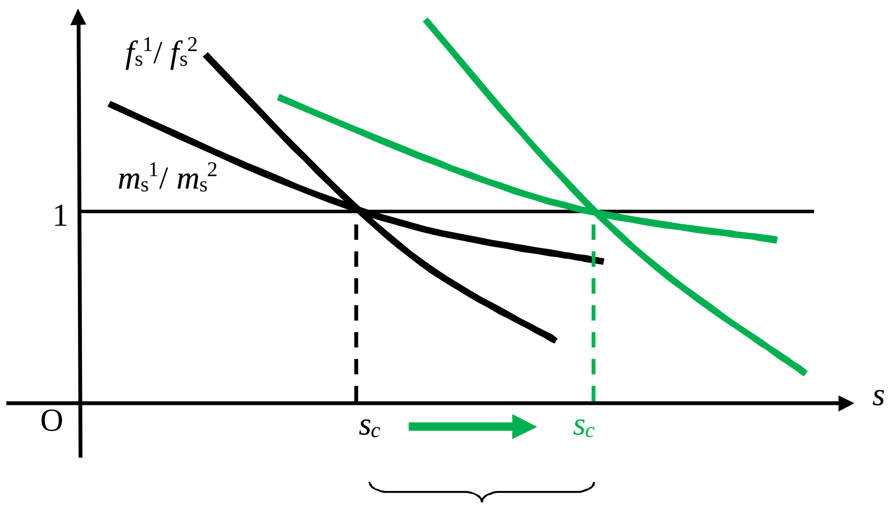
Globalization, a higher $\rho = (\tau)^{1-\sigma}$**, when two countries are equal in size:** $L^1 = L^2 = L$

$$\omega = 1 \rightarrow x_\rho^j = (1+\rho) x_0^j = (1+\rho)\left(h^j\right)^\sigma N^j = (1+\rho)\left(h^j\right)^{\sigma-1} L$$

The relative factor price fixed at ω = 1 and independent of ρ. No ToT change

- The country with higher labor productivity is richer.
- a higher ρ is isomorphic to a uniform increase in h.

Figure 4: Globalization: Patterns of Structural Change and Product Cycles



The richer country's sectoral trade balances switch from surpluses to deficits

Globalization, a higher $\rho = (\tau)^{1-\sigma}$, when two countries are unequal in size:

Globalization causes the ToT to change in favor of the smaller country

Leapfrogging and Reversal of the Patterns of Trade

For $h^1 / h^2 > 1$ and below the Red curve,

$U_\rho^1 < U_\rho^2$ at a low ρ

Closer to autarky, Country 1 is poorer due to its disadvantage of being smaller, running surpluses in lower-indexed.

$U_\rho^1 > U_\rho^2$ at a high ρ

Globalization leads to a factor price convergence, which makes the smaller but smarter 1 richer, running surpluses in higher-indexed.

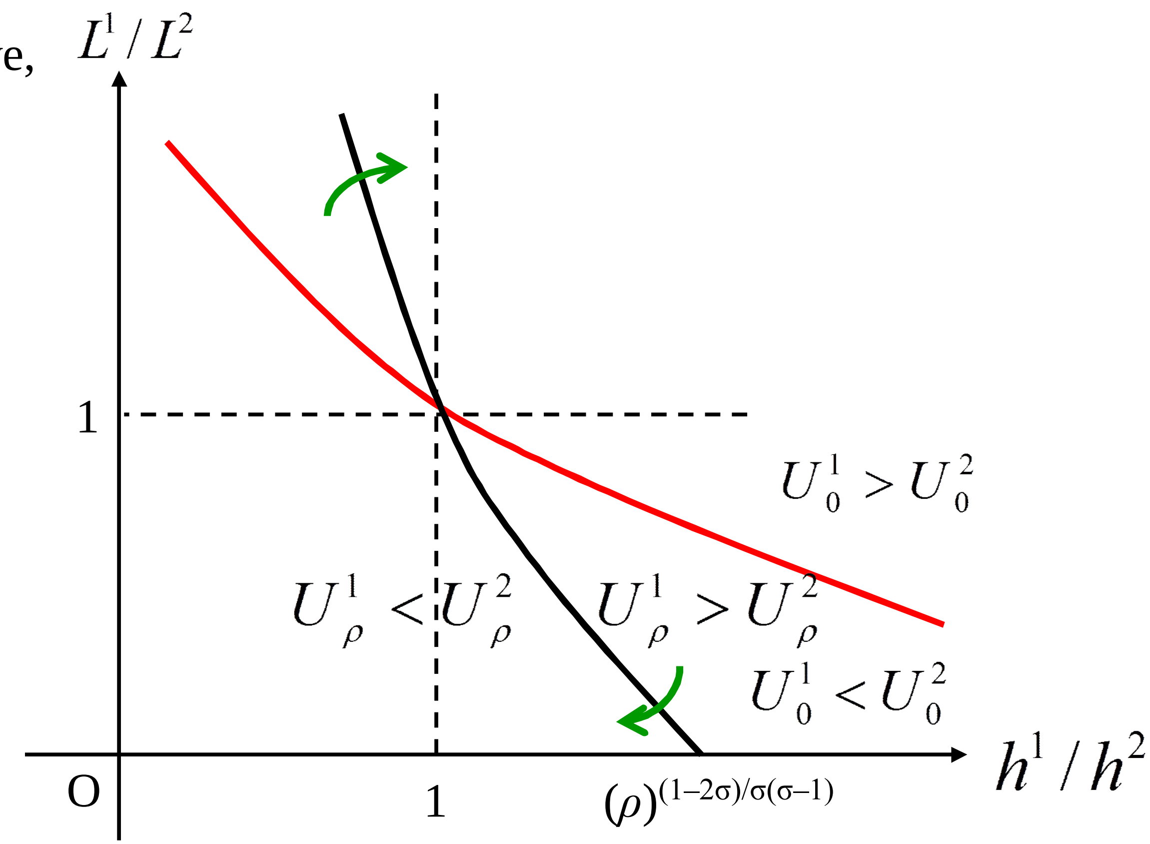


Figure 5

Concluding Remarks

- *Engel's Law* with implications on
  - i) Sectoral compositions in employment, innovation, and productivity growth.
  - ii) Patterns of trade and migration of industries across rich and poor countries
- A unifying framework, capturing all these effects and their interactions
  - ✓ **Two Countries** differ in population size and labor productivity
  - ✓ **Nonhomothetic CES** over a continuum of nontradeable consumption goods
  - ✓ **Endogenous Sectoral Productivity** due to the DS variety effect
  - ✓ **Costly Trade**

- **Home Market Effect** in employment and patterns of trade
  - ✓ Disproportionately large share of workers in higher income elastics in Rich
  - ✓ *Linder Effect:* Rich (Poor) a net-exporter in higher (lower) income elastics
- **Comparative Statics:** *Labor productivity growth and globalization cause*
  - ✓ *Sectoral Change* to the higher income elastics
  - ✓ *Schmookler Effect;* Relative Price of high income elastics go down
  - ✓ *Vernon's Product cycles:* Rich switches from an exporter to an importer in the middle sectors
  - ✓ *Leapfrogging* and *patterns of trade reversal* Globalization can help the smaller country with better labor force to overtake the other.

- Implicit Additive Nonhomothetic CES (Explicit additivity, e.g., Stone-Geary, CRIE, are too inflexible, too restrictive, cannot isolate the effects of income effects.)

Directions for Future Research

- *Multiple factors of production* (e.g., skilled & unskilled labor) with correlation btw the factor intensity (e.g., skilled intensity) and the income elasticity across sectors

- *Sector-specific trade costs* with correlation btw trade costs and income elasticity (e.g., high income elastic sectors have higher service components that are less tradeable)

- Multiple countries/regions with some *geographical features*
  - ✓ *Ceteris paribus*, the most centrally located country/region would have the highest per capita real income, and becomes the net-exporter in the most income elastic sectors
  - ✓ The countries/regions immediately next to the most centrally located country/region might become net-exporters in the least income elastics, due to the "*shadow effect*"
  - ✓ The countries/regions in the peripheries might become net-exporters in the middle.

- Nonhomotheticity *across as well as within* sectors
  - ✓ Nested isoelastically nonhomothetic CES, with η higher within sectors than across
  - ✓ Combining isoelastically nonhomothetic CES across sectors with horizontally differentiation with non-CES within sectors
  - ✓ Combining isoelastically nonhomothetic CES across sectors with vertical (quality) differentiation within sectors.