Growth, Trade, and Inequality

Gene Grossman   Elhanan Helpman

July 2014
Theoretical exploration of link between growth process and income distribution in the closed and open economies

Focus on one mechanism:

- **Sorting** of heterogeneous workers into idea-generating and manufacturing activities
- **Matching** of workers in manufacturing with heterogeneous firms/technologies

Many other mechanisms are absent; e.g.,

- Differences in savings propensity between rich and poor (Kaldor)
- Poor households face credit constraints (Galor and Zeira)
- Greater inequality generates more redistribution via political process (Alesina and Rodrik; Persson and Tabellini)
Demand and Supply of Consumption Goods

- Mass $N$ of heterogeneous individuals, indexed by $a$
- Cumulative distribution $H(a)$, with $H'(a) > 0$ on $[a_{\text{min}}, a_{\text{max}}]$
- Logarithmic intertemporal utility
- Consumption good assembled from CES differentiated intermediate inputs; consumption good priced competitively

Grossman and Helpman (2012) Growth, Trade, and Inequality
Production of Intermediates

- Production of intermediates
  \[ x_\omega = \int_{a \in L_\omega} \psi(\phi_\omega, a) \ell_\omega(a) \, da \]

- Assume \( \psi(\phi, a) \) is twice differentiable and strictly log supermodular
  - For arbitrary wage schedule, firm hires optimal labor type \( m(\phi) \)
  - PAM: \( m'(\phi) > 0 \)

- Monopolistic competition yields mark-up pricing of intermediates.
Inventing New Varieties

- **Invention of new varieties à la Romer**
  - Stock of knowledge: $\theta_K M$
  - Worker of type $a$ has productivity $T(a)$ in research sector
  - $\ell_R(a)$ workers of type $a$ invent $dM = \theta_K M T(a) \ell_R(a)$ new varieties per time $dt$ (strong scale effects)

- Each invention generates a “Melitz draw” of $\varphi$ from $G(\varphi)$

- Allow free entry into innovation
Inventing New Varieties

- Invention of new varieties à la Romer
  - Stock of knowledge: $\theta_K M$
  - Worker of type $a$ has productivity $T(a)$ in research sector
  - $\ell_R(a)$ workers of type $a$ invent $dM = \theta_K M T(a) \ell_R(a)$ new varieties per time $dt$ (strong scale effects)

- Each invention generates a “Melitz draw” of $\varphi$ from $G(\varphi)$

- Allow free entry into innovation

- Comparative advantage in ideas: Assume $T(a)/\psi(\varphi, a)$ is increasing in $a$ for all $(\varphi, a)$
Inventing New Varieties

- Invention of new varieties à la Romer
  - Stock of knowledge: $\theta_K M$
  - Worker of type $a$ has productivity $T(a)$ in research sector
  - $\ell_R(a)$ workers of type $a$ invent $dM = \theta_K M T(a) \ell_R(a)$ new varieties per time $dt$ (strong scale effects)
- Each invention generates a “Melitz draw” of $\varphi$ from $G(\varphi)$
- Allow free entry into innovation

- Comparative advantage in ideas: Assume $T(a) / \psi(\varphi, a)$ is increasing in $a$ for all $(\varphi, a)$
- $\Rightarrow$ Sorting: $\exists a_R$ (“cutoff”) such that $a < a_R \Rightarrow a \in L_M$ and $a > a_R \Rightarrow a \in L_R$ (like “occupational choice” in Lucas 78)
Labor-market Equilibrium

- **Labor market clearing:** Supply of workers of type \( m(\varphi) \) equals demand for workers by firms of type \( \varphi \)

- Differentiate this condition

\[
\frac{m''(\varphi)}{m'(\varphi)} = (\sigma - 1) \frac{\psi_{\varphi}[\varphi, m(\varphi)]}{\psi[\varphi, m(\varphi)]} - \frac{\psi_a[\varphi, m(\varphi)]}{\psi[\varphi, m(\varphi)]} m'(\varphi)
\]

\[+ \frac{G''(\varphi)}{G'(\varphi)} - \frac{H''[m(\varphi)]}{H'[m(\varphi)]} m'(\varphi)\]

- **Boundary conditions**

\[m(\varphi_{\text{min}}) = a_{\text{min}}, \quad m(\varphi_{\text{max}}) = a_R\]
Differential equation has unique solution for given $a_R$

If boundary points change and none of terms in diff eq change, new and old matching functions can intersect at most once.
Equilibrium Matching Function

- Differential equation has unique solution for given $a_R$
- If boundary points change and none of terms in diff eq change, new and old matching functions can intersect at most once

So, $a_R \uparrow \Rightarrow$ (inverse)-matching function shifts down
  - every worker matches with lower productivity firm
  - due to log supermodularity of $\psi \left( \cdot \right)$, log wage profile on $[a_{\text{min}}, a_R]$ must flatten (steepen) when $a_R$ increases (decreases)
Balanced-Growth Path

\[ g_M = \theta_K N \int_{a_R}^{a_{\text{max}}} T(a) \, dH(a) \]  

(RR)

Combining labor-market clearing and free-entry condition:

\[ \rho + g_M = \theta_K N \Lambda(a_R) \]  

(AA)
Analysis of Balanced Growth Paths

Two Types of Results

- Autarky
  - How do cross-country differences generate differences in autarky (steady-state) growth rates and wage inequality?

- Integration
  - How does trade integration affect countries’ growth rates and inequality?
  - How do growth and inequality compare across countries in a trade equilibrium?
Capacity to innovate described by three parameters

- Size of labor force: $N_c$
- Efficiency of knowledge accumulation: $\theta_K$
- Productivity of inventors: $\theta_T$

In $RR$ and $AA$ curve, these parameters enter as product: $N_c\theta_K\theta_T$

If $N_i\theta_K\theta_T > N_j\theta_K\theta_T \Rightarrow a_{Ri} < a_{Rj}$ and $g_{Mi} > g_{Mj}$

Income inequality:

- More unequal wages in manufacturing in $i$ than in $j$ due to better technology matches
- Larger size of research sector, which pays higher reward to ability
- $\Rightarrow$ more inequality!
International Integration: Trade and Knowledge Spillovers

- $C$ countries
- Costly trade in intermediate goods due to tariffs and/or shipping. Delivered price in $j$ is $\tau_{jc}$ times as great as source price in $c$.
- Final goods nontradable
- R&D subsidies at rate $s_c$
- Asymmetries: $\theta_{\psi c}, \theta_{Tc}, N_c$
- Partial (or complete) knowledge spillovers:

$$K_c = \sum_{j=1}^{C} \theta_{Kjc} M_j; \theta_{Kjc} > 0 \text{ for all } j \text{ and } c$$
Effects of Trade on Growth and Inequality

- Convergence in long-run growth rates.

- Opening of trade: analogous to increase in $\theta_K$ in closed economy.
  - More labor allocated to R&D in every country.
  - Growth rate faster in every country.
  - Greater income inequality in every country.
International Asymmetries

- Differences in Manufacturing Productivity and Trade Barriers
  - Convergence in growth rates and wage inequality
  - Change in $\tau_{jc}$ or $\theta_{\psi_c}$ have no effect on long-run growth or inequality

- Differences in Innovation Capacity or in Ability to Create and Absorb Knowledge Spillovers
  - Convergence in growth rates and wage inequality

- Differences in R&D Subsidies
  - If $s_i > s_j$ and international knowledge spillovers are complete, then $a_{Ri} < a_{Rj}$ and more wage inequality in $i$ than in $j$

- Differences in Technology Sets
  - If $\bar{\phi}_i > \bar{\phi}_j$ and international knowledge spillovers are complete, then $a_{Ri} > a_{Rj}$
  - Greater inequality in $i$ than in $j$ at bottom of distribution, but at least as great inequality in $j$ at top.
Conclusions

- International integration affords researcher access to larger knowledge stock $\Rightarrow$ accelerates innovation and growth
- Expansion of idea-generating sector generates ubiquitous increase in income inequality
- Technological conditions and government policies typically have spillover effects abroad
Conclusions

- International integration affords researcher access to larger knowledge stock ⇒ accelerates innovation and growth
- Expansion of idea-generating sector generates ubiquitous increase in income inequality
- Technological conditions and government policies typically have spillover effects abroad

- Have abstracted from
  - Diversity in manufacturing industries (factor intensities, etc.)
  - Team production activities that involve multiple individuals
  - Capital inputs that may be complementary to certain types of worker or inventors
  - Market frictions in labor market and in financing new ideas
  - Superstar potential for those at top end, especially in open economy