Trading Population for Productivity: Theory and Evidence
Oded Galor and Andrew Mountford
(2008; Review of Economic Studies)
presented by Salvatore Lo Bello
Macro Reading Group - Universidad Carlos III de Madrid
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The Great Divergence

- **Great Divergence**: dramatic transformation in the income and population distribution.
  - how to account for the sudden take-off of some countries?
  - why have differences across countries increased?

- **This paper**: what is the role played by international trade?
  - Results: trade can alter the transition from Malthusian to modern economies.
  - Mechanism: *asymmetric* effect of trade on different countries, through specialization.
This Paper: Unified Growth Theory with Trade

- **Unified growth theory** that captures the role of trade in the process of economic growth.

- **Contributions:**
  1. Analysis of differential patterns of takeoffs across regions.
  2. Focus on interaction between population growth and comparative advantage.

- **The Economic Growth Process:**
  
  Maltusian Epoch $\rightarrow$ Tech. Adv.
  
  $\rightarrow$ Structural Change
  
  $\rightarrow$ Demographic Transition

- Trade intervenes in (2):
  - *speeding up* the process for developed countries;
  - *slowing down or blocking* the process for underdeveloped countries.
Setup and Production

- **OLG economy.** Individuals live for 2 periods. Infinite discrete time.

- **2 goods:** $Y^m_t$, $Y^a_t$. Produced with 3 inputs: $H_t$, $L_t$, $X$.

- Each sector has 2 technologies:

  $$
  Y^a,O_t = a^a_t (L^a,O_t)^\gamma X^{1-\gamma}
  $$
  $$
  Y^m,O_t = a^m_t H^m,O_t
  $$
  $$
  Y^a,N_t = A^a_t L^a,N_t
  $$
  $$
  Y^m,N_t = A^m_t F(H^m_t, L^m,N_t)
  $$

- In *early* phases of development, the *old* technologies are used.
Households’ Problem

- Optimization problem of member $i$ ($i \in \{u, s\}$) born at $t - 1$:

$$\{c_t^{i,a}, c_t^{i,m}, n_t^{i,s}, n_t^{i,u}\} = \text{argmax}(c_t^{i,a})^\alpha(c_t^{i,m})^\beta[w_{t+1}n_t^{i,s} + w_{t+1}n_t^{i,u}]^{1-\alpha-\beta}$$

s.t.  

$$p_t c_t^{i,a} + c_t^{i,m} + w_i(n_t^{i,s}\tau^s + n_t^{i,u}\tau^u) \leq w_i$$

$$c_t^{i,a} \geq \tilde{c}$$

- In equilibrium, $n_t^{i,s} > 0$ and $n_t^{i,u} > 0$ if $w_{t+1}^s/w_{t+1}^u = \tau^s/\tau^u$.

$$\iff \frac{H_t^m}{L_t^m} = h_t^m = (h_m)^*$$
Viability of the New Technologies

- The new **industrial** technology is *economically viable* if:
  \[
  \frac{A_t^m}{a_t^m} \geq \frac{1}{w^u((h^m)^*)} \tag{1}
  \]

- The new **agricultural** technology is *economically viable* if:
  \[
  \frac{A_t^a}{a_t^a} \geq (L_t^a, O)_{\gamma-1} \tag{2}
  \]
Technological Progress

- **General Purpose Technology**: $\lambda_t$.

  $$g_{t+1} = \frac{\lambda_{t+1} - \lambda_t}{\lambda_t} = g(h_t) \quad \text{with} \quad g'(h_t) > 0$$

- **(A1)**: at time 0, the new technologies are NOT economically viable.

- **(A2)**: $\frac{dA^m(\lambda_t)}{d\lambda_t} > \frac{dA^a(\lambda_t)}{d\lambda_t} > \frac{da^m(\lambda_t)}{d\lambda_t} > \frac{da^m(\lambda_t)}{d\lambda_t} > 0$.

- **(A3)**: $(t^m)^*, (t^a)^*$ are the first periods in which the new technologies become viable. It is assumed: $(t^a)^* < (t^m)^*$. 
Dynamics and Modern Industrial Stage

- **Human Capital** (3 regimes):
  - zero until the new industrial technology is used. Increases with technology until subsistence constraint is not binding anymore.

- **Population** (4 regimes):
  - it grows at the same low rate of technology \( t < (t^a)^* \); Malthusian economy;
  - it grows fast, due to better technology in agriculture \( ((t^a)^* < t < (t^m)^*) \);
  - it starts to decrease its pace \( ((t^m)^* < t < \tilde{t}) \);
  - it converges to a lower rate \( t > \tilde{t} \);

**Balanced Growth Path**
The economy converges to a Balanced Growth Path, with constant growth population rate and fixed ratio of skilled to unskilled workers. The fertility rate (human capital accumulation) is lower (higher) than in the previous stage.
Country A (technologically advanced) has a **comparative advantage** in the industrial sector:

\[
\frac{A_t^{m,A}}{A_t^{a,A}} > \frac{A_t^{m,B}}{A_t^{a,B}}
\]

International prices will lie between the autarkic prices:

\[
p_t^B \leq p_t^* \leq p_t^A \implies \text{specialization} \left\{ \begin{array}{l} A \implies Y_m \\ B \implies Y_a \end{array} \right. 
\]

Implications of trade:

1. Rate of population growth in A (B) is affected negatively (positively);
2. Demographic transition in A (B) is accelerated (delayed, perhaps indefinitely);
3. The technological gap **widens**.
The Empirical Tests

- Test empirically the hypothesis of trade’s effects on fertility and human capital formation.

- Study the marginal effect of share of trade to GDP on: TFR, change in the average years of schooling.

- Use a *pre-existing* division of the world economy (OECD / Non-OECD).

- The theory predicts *opposite* effects on the two subsamples.
## Results: Trade on TFR

<table>
<thead>
<tr>
<th></th>
<th>Average Total Fertility Rate (TFR), 1985-1990</th>
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<tbody>
<tr>
<td></td>
<td>Non-OECD Economies</td>
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<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>ln(Trade/GDP) 1985</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>0.21</td>
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<tr>
<td>(0.17)</td>
<td>(0.14)</td>
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<tr>
<td>ln(GDP/pc) 1985</td>
<td></td>
</tr>
<tr>
<td>(2)</td>
<td>-1.66***</td>
</tr>
<tr>
<td>(0.14)</td>
<td>(0.27)</td>
</tr>
<tr>
<td>Average Infant Mortality 1985-90</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>0.03***</td>
</tr>
<tr>
<td>Number of countries</td>
<td>108</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.58</td>
</tr>
</tbody>
</table>

(i) Regressions (3), (4), (7) and (8) employ the Frankel-Romer IV for log of trade share in GDP in 1985.
(ii) Robust standard errors in parentheses.
(iii) One sided tests are performed that the coefficients on trade are of the predicted sign.
(iv) ***denotes significance at the 1% level **significance at the 5% level and *significance at the 10% level.
Results: Trade on Change in years of schooling

Table 2: The Effect of Trade on Education

<table>
<thead>
<tr>
<th></th>
<th>Changes in the Average Years of Education, 1985-1990</th>
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<tbody>
<tr>
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<td>Non-OECD Economies</td>
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<td>OLS</td>
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<tr>
<td>ln(Trade/GDP) 1985</td>
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<tr>
<td></td>
<td>−0.10</td>
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<td></td>
<td>(0.08)</td>
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<td>ln(GDP/pc) 1985</td>
<td></td>
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<tr>
<td></td>
<td>0.15**</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td>Number of countries</td>
<td>74</td>
</tr>
<tr>
<td>R²</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The effect of the share of trade in GDP in 1985 on the change in the average years of total education (for population above the age 15) in the periods: 1985-1990

(i) Regressions (2) and (4) employ the Frankel-Romer IV for log of trade share in GDP in 1985
(ii) Robust standard errors in parentheses
(iii) One sided tests that the coefficients on trade are of the predicted sign.
(iv) *** denotes significance at the 1% level ** significance at the 5% level * significance at the 10% level.
Concluding Remarks

- Assessment of the role of trade in the transformation in the distribution of income and population

- **Asymmetric** (and **persistent**) effect of trade on the timing of demographic transition.

- Development and underdevelopment patterns **jointly** reinforced by a common factor.

- Abstract from cultural and institutional factors.