Comparative Economic Development: Insights from Unified Growth Theory

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Outline

- Introduction
- Historical Evidence
- Unified Growth Theory
- Implications for Comparative Development
The Complexity of the Process of Development

- The Malthusian Epoch
  - Developed Countries: 100,000 BCE - 1750
  - Less Developed Economies: 100,000 BCE - 1900

- The Post Malthusian Regime
  - Developed Countries: 1750 - 1870
  - Less Developed Economies: 1900 -

- The Modern Growth Regime
  - Developed Countries: 1870 - present
  - Less Developed Economies
Major Puzzles

Context: The Malthusian Epoch

- What accounts for the epoch of stagnation that characterized most of human history?

- Why had episodes of technological progress in the pre-industrialization era failed to generate sustained economic growth?

- Why has population growth counterbalanced the expansion of resources per capita that could have been generated by technological progress?
...Major Puzzles

Context: The Transition from Stagnation to Growth

- What is the origin of the sudden spurt in growth rates of output per capita and population?

- What triggered the demographic transition?

- Would the transition to a state of sustained economic growth have been feasible without the demographic transition?

- What are the underlying behavioral and technological structures that account for the distinct phases of development and what are their implications for the contemporary growth process of developed and underdeveloped countries?
Major Puzzles

Context: Comparative Development

- What accounts for the sudden take-off from stagnation to growth in some countries and the persistent stagnation in others?

- Why has the positive link between income and population growth reversed its course in some economies but not in others?

- Why have the differences in per capita income across countries increased so markedly in the last two centuries?

- Has the transition to a state of sustained economic growth in advanced economies adversely affected the process of development in less-developed economies?
Inconsistency of non-UGT with the Growth Process

- Inconsistent with the qualitative aspects of the growth process during the Malthusian epoch and the Post-Malthusian Regime
- Limited to the modern growth regime – a small fraction of the entire process of development
- Do not capture the forces that brought about the transition of developed countries from stagnation to growth and hence unable to shed light of the hurdles faced by LDCs in their attempt to take-off to a state of sustained economic growth
- Unable to capture fundamental aspects of sustained differences in income per-capita across countries
Lessons from other Scientific Disciplines

- Theories that are founded on the basis of a subset of existing observations and their driving forces, may be attractive in the short run, but non-robust and ultimately non-durable in the long run:

- Classical Thermodynamics:
  - Lacks micro-foundations - has been ultimately superseded by the micro-based Statistical Mechanics

- Unified Field Theory
  - Proposes to unify by general laws the four distinct forces that control observed interactions in matter: electromagnetism, gravitation, the weak force, and the strong force
Lessons from other Scientific Disciplines

- Attempts to develop unified theories in Physics have been based on the conviction that all physical phenomena should ultimately be explainable by some underlying unity.

- The entire process of development and its fundamental forces ought to be captured by a unified growth theory.
Virtues of Unified Growth Theory

- Sheds light on historical and contemporary patterns of development
- Identifies the forces the permitted the currently developed economy to transit from an epoch of Malthusian stagnation to sustained economic growth
- Uncovers the hurdles faced by LDCs in their transitions from stagnation to growth
- Derives policies that may expedite the transition of LDCs to sustained economic growth
...Virtues of Unified Growth Theory

- Demonstrates the critical role played by the demographic transition and the emergence of the demand for human capital in the shift to modern growth

- Identifies the micro-foundations - the central driving forces - for the main aspects of the growth process

- Provides a meta-theory that naturally encompasses existing hypothesis about the role of geography, institutions, and the composition of human traits, in comparative development
Historical Evidence

- The Malthusian Epoch
- The Post-Malthusian Regime
- The Sustained-Growth Regime
- The Great Divergence
World Income per Capita: 0-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP Per Capita (1990 Int'l $)</th>
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<tbody>
<tr>
<td>0</td>
<td>445</td>
</tr>
<tr>
<td>1000</td>
<td>436</td>
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<td>1973</td>
<td>4091</td>
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<td>2001</td>
<td>6049</td>
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</table>
Regional Income per Capita, 0-2000

- Western Europe
- Western Offshoots
- Asia
- Latin America
- Africa
- Eastern Europe
### Inequality in Income Per Capita, 0-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Western Offshoots</th>
<th>Western Europe</th>
<th>Latin America</th>
<th>Asia</th>
<th>Africa</th>
<th>Ratio: Rich/Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>400</td>
<td>450</td>
<td>400</td>
<td>450</td>
<td>425</td>
<td>1.1 : 1</td>
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<td>1202</td>
<td>1,204</td>
<td>692</td>
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<td>2001</td>
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<td>19,265</td>
<td>6,150</td>
<td>3861</td>
<td>1,489</td>
<td>18 : 1</td>
</tr>
</tbody>
</table>
The Malthusian Epoch

Economies are in a Malthusian stagnation:

- Population growth is positively affected by the level of income per capita
- Technological progress exits but it is slow and it results in a proportional increase in output and population
- Output per capita fluctuates around a subsistence level
Malthusian Fluctuations in GDP Per Capita: England, 1260-1870
Malthusian Relationship between World Income and Population

![Graph showing the Malthusian Relationship between GDP per Capita and Population](#)
Malthusian Relationship between World Income and Population Growth
Malthusian Relationship between Income and Population: England 1250-1750
Testable Implications

- Variations in technology and land quality across countries will be reflected primarily in variation in population density:
  - Technological superiority will result primarily in higher population density without any sizable effect on income per-capita in the long-run
  - Superior land quality will result primarily in higher population density without any sizable effect on income per-capita in the long-run
Timing of Neolithic and Population Density in 1500 CE

Transition Timing and Population Density in 1500 CE

Adjusted for Land Productivity and Continental Fixed Effects

Log Population Density in 1500 CE vs. Log Years since Transition

- Africa
- Europe
- Asia
- Oceania
- Americas

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Land Productivity and Population Density in 1500 CE

Adjusted for Transition Timing and Continental Fixed Effects

Log Population Density in 1500 CE

Log Land Productivity

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The Post-Malthusian Regime

Economies take-off from a Malthusian equilibrium:

- Population growth is still positively affected by the level of income per capita
- Technological progress accelerates and it results in a larger increase in output than in population
- Demand for education increases towards the end of the period
- Income per capita and population grow at an increasingly faster pace
Take-off in World Income Per Capita

<table>
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<tr>
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<th>0</th>
<th>1000</th>
<th>1500</th>
<th>1600</th>
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</table>
Regional Variations in the Timing of the Take-off (Levels): Early Take-Off
Regional Variations in the Timing of the Take-off: (Levels)

Late Take-Off

![Graph showing Regional Variations in the Timing of the Take-off](image-url)
Growth of GDP Per Capita and Population: Western Europe, 1500-2000

Western Europe

Percent Growth Rates

output growth
population growth

0
0.5
1
1.5
2
2.5
3

1500 1600 1700 1800 1900 2000

0
0.5
1
1.5
2
2.5
3

output growth
population growth

1500 1600 1700 1800 1900 2000
Growth of GDP Per Capita and Population: Western Offshoots, 1500-2000
Growth of GDP Per Capita and Population: Latin America 1500-2000
Growth of GDP Per Capita and Population: Africa 1500-2000
Industrialization: Less Developed Economies

![Graph showing output growth and population growth in Asia excluding Japan, with data points for 1500 to 2000 AD.](image-url)
The Modern Growth Regime

Sustained economic growth:

- Technological progress accelerates
- Human capital becomes a major factor of production
- Population growth declines – The Demographic Transition
- Gains in total output are not counterbalanced by population growth
- Output per capita grows at a high sustainable level
The acceleration in the rate of technological progress increased the demand for human capital.

The rise in the demand for human capital induced a substitution of quality for quantity of children triggering a demographic transition.

The demographic transition should be observed at the same time period across economies, that may differ in their levels of incomes per capita, but are similar in their growth rates of income per capita.
...The Rise in the Demand for Human Capital
Timing of the Demographic Transition across Regions: Early Transition

![Early Demographic Transition Graph](image)

- Western Europe
- Western Offshoots
- Eastern Europe

Rate of Population Growth: 1750 to 2000

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Timing of the Demographic Transition across Regions: Late Transition

Late Demographic Transition

Rate of Population Growth

- Latin America
- Asia
- Africa

0
0.5
1
1.5
2
2.5
3
1750 1800 1850 1900 1950 2000

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Variations in the timing of the Transition: The Great Divergence: Income per Capita
The Great Divergence in Population: Africa and Latin America Vs. Western Europe

![Graph showing population growth over time in Western Europe, Latin America, and Africa](image-url)
Sustained Economic Growth: Western Europe and Western Offshoots, 1870-2001
Contributions

- **Underlying Philosophy:**

- **Foundations:**

- **Extensions:**
  Hansen and Prescott (AER 2002), Lagerlof (IER 2003), Boucekkine, de la Croix and Peeters (JEEA 2006), O’Rourke, Rhaman and Taylor (2007)

- **Human Evolution and Economic Development:**
...Main Contributions

- **UGT and Comparative Development:**

- **Calibrations:**

- **Historical Evidence and Evaluations**
The Fundamental Challenges

Development of a unified growth theory that accounts for:

- An epoch of Malthusian stagnation
- Take-off to a Post-Malthusian Regime
- Emergence of human capital formation
- Demographic transition
- A shift to sustained economic growth
Two dimensions of “unification”:

- Unifying the entire process of development

- Unifying the micro structure of the economy
  (i.e., the structure of preferences and technologies remain unchanged, but endogenous changes in the economic environment triggers different choices in different stages of development)
A dynamical system that permits an escape from a stable Malthusian Steady-State:

- A major shock in an environment characterized by multiple locally stable equilibria (inconsistent with evidence of a gradual transition (Crafts))

- A gradual escape from an absorbing (stable) equilibrium (contradiction to the essence of a stable equilibrium)
Methodological innovation:

- Phase transition via the evolution of latent state variables that ultimately affects the qualitative properties of the dynamical system

- Although output per capita remains unchanged, the evolution of latent state variables (technology and population) ultimately changes the dynamical system qualitatively, the Malthusian equilibrium vanishes endogenously, leaving the arena to the gravitational forces of the emerging Sustained Growth Regime
Major Puzzles Resolved by UGT

Context: The Transition from Stagnation to Growth

- What accounts for the epoch of stagnation that characterized most of human history?

- What is the origin of the sudden spurt in growth rates of output per capita and population?

- Why had episodes of technological progress in the pre-industrialization era failed to generate sustained economic growth?
...Major Puzzles Resolved by UGT

Context: The Transition from Stagnation to Growth

- What triggered the demographic transition?

- Would the transition to a state of sustained economic growth have been feasible without the demographic transition?

- What are the underlying behavioral and technological structures that could simultaneously account for these distinct phases of development and what are their implications for the contemporary growth process of developed and underdeveloped countries?
...Major Puzzles Resolved by UGT

Context: The Great Divergence

- What accounts for the sudden take-off from stagnation to growth in some countries and the persistent stagnation in others?

- Why has the positive link between income and population growth reversed its course in some economies but not in others?

- Why have the differences in per capita income across countries increased so markedly in the last two centuries?

- Has the transition to a state of sustained economic growth in advanced economies adversely affected the process of development in less-developed economies?
Suggestive Evidence: Characteristics of the Main Transitions

- Transition from Malthusian to Post-Malthusian Regime:
  - Faster rates of technological progress
  - Faster rate of population growth

- Transition from the Post-Malthusian to Modern Growth Regime:
  - Faster rate of technological progress
  - Faster rate of human capital accumulation
  - Decline in population growth
Suggestive Evidence

- A solution to these fundamental puzzles may be hidden therefore in the understanding of how:
  - changes in the technological environment affects the population size and its quality.
  - the size and the quality of the population affect the rate of technological progress
Main Elements

- The Malthusian Structure
- Sources of Technological Progress
- Origins of Human Capital Formation
- Triggers of the Demographic Transition
The Malthusian Structure

- A subsistence consumption constraint
- Positive effect of income on population
  - reflecting household’s optimization
- Output per capita is stationary
  - reflecting diminishing returns to labor in agriculture and a positive effect of income on population
Sources of Technological Progress

Early stage of development

- Population size positively affects technological progress via:
  - Supply of innovations
  - Demand for innovations
  - Diffusion of knowledge
  - Division of labor
  - Extent of trade
...Sources of Technological Progress

Later Stages of Development

- Human capital positively affects technological progress
  - Educated individuals have a comparative advantage in adopting and advancing new technologies
  - Population scale is still beneficial, as long as it does not come on the account of population quality
The increase in the rate of technological progress increases the demand for human capital

- Human capital permits individuals to better cope with the changes in the technological environment

- The introduction of new technologies is skill-biased in the short-run, although the nature of the technology is skill-biased or skill-saving in the long run
Triggers of the Demographic Transition

- The rise in the *demand* for human capital in the second phase of Industrialization induces parents to substitute quality for quantity of children.

- The rise in income along with the rise in the potential return to human capital generates:
  - An income effect - more income to spend on children
  - Substitution effects -
    - the opportunity cost of raising children increases
    - the potential return to investment in children’s human capital increases
Early part of the second phase of industrialization:

- The income effect dominates and population growth and human capital formation increases:
  - The subsistence consumption constraint (that adversely affect resources devoted to children) has a larger effect at low levels of income
  - The demand for human capital is moderate
Later part of the second phase of industrialization:

- The substitution effect dominates, population growth declines and human capital formation increases further.

- The subsistence consumption constraint (that adversely affect resources devoted to children) has a lower effect at high levels of income.

- The demand for human capital is more significant.
The Malthusian Regime

- The economy is a Malthusian steady-state equilibrium
- Technological progresses is slow
- The return to human capital is low, and parents have no incentive to substitute child quality for quantity
- The temporary increase in income increases population proportionally
- Output per capita fluctuates initially around a stationary level, and then around an increasing, but minor trend.
The Post-Malthusian Regime

- Technological progress becomes more rapid due to the increase in the population size and quality and it permits the economy to take-off from the Malthusian regime

- The pace of technological progress increases

- The demand gradually increases towards the end of the period
Technological progress and the rise in the demand for human capital has two effects on population growth:

- Income Effect: More resources for raising children
- Substitution Effect: Reallocation towards child quality

The income effect dominates and both population quantity and quality increases

Output per capita increases along with an increase in the rate of population growth
Demographic Transition and Sustained Growth

- Technological progress intensifies further due to the gradual increase in the level of human capital.

- The demand for human capital further increases.

- Parents are induced to further substitute child quality for quantity.

- The substitution effect dominates and fertility rates decline permanently.

- The economy converges to a steady-state where output per capita may grow at a positive rate and population growth is moderate.
The Basic Structure of the Model

- Overlapping-generations economy
- \( t = 0, 1, 2, 3 \ldots \infty \)
- One homogeneous good
- 2 factors of production:
  - Labor (measured in efficiency units)
  - Land
Production

- The output produced in period $t$
  
  \[ Y_t = H_t^\alpha (A_t X)^{1-\alpha} \]

  - $H_t$ - efficiency units of labor
  - $X$ - land

- Output per worker produced at time $t$
  
  \[ y_t = h_t^\alpha x_t^{(1-\alpha)} \equiv y(h_t, x_t) \]

  - $h_t \equiv H_t/L_t$ - efficiency units per-worker
  - $x_t \equiv (A_t X)/L_t$ - effective resources per worker
Factor Supply

- Land is fixed over time

- Efficiency units of labor evolves endogenously
  - determined by households’ decisions about the number and level of human capital of their children
Individuals

- Live for 2 periods

- Childhood: (1st Period):
  - Consume a fraction of their parental unit-time endowment. The required time increases with children’s quality.

- Parenthood (2nd Period):
  - Allocate time between childrearing and work.
  - Choose the optimal mixture of quantity and quality of children.
  - Supply their remaining efficiency units of labor.
  - Earn the competitive market wage.
  - Consume.
Preferences

The Utility function of individual $t$

$$u^t = (c_t)^{(1-\gamma)}(n_t h_{t+1})^{\gamma}$$

- $n_t$ - number of children of individual $t$
- $h_{t+1}$ - level of human capital of each child
Budget Constraint

Second period budget constraint:

\[ w_t h_t n_t (\tau + e_{t+1}) + c_t \leq w_t h_t \]

- \( \tau + e_{t+1} \) time needed to raise a child with education \( e_{t+1} \)
- \( \tau \) time required to raise a child, regardless of quality
Human Capital Formation

Human capital of children of generation $t$

$$h_{t+1} = h(e_{t+1}, g_{t+1})$$

- $g_{t+1} \equiv (A_{t+1} - A_t)/A_t$ - rate of tech progress
- $e_{t+1}$ - education

- $h_{eg}(e_{t+1}, g_{t+1}) > 0$
- $h_e(e_{t+1}, g_{t+1}) > 0$, $h_{ee}(e_{t+1}, g_{t+1}) < 0$, $h_g(e_{t+1}, g_{t+1}) < 0$, $h_{gg}(e_{t+1}, g_{t+1}) > 0$
Optimization

\[ \{n_t, e_{t+1}\} = \arg\max \{ w_t h_t[1 - n_t(\tau + e_{t+1})]\}^{1-\gamma} \{(n_t h(e_{t+1}, g_{t+1})\}\}^\gamma \]

Subject to:

\[ w_t h_t[1 - n_t(\tau + e_{t+1})] \geq \tilde{c} \]
Income Expansion Path

Time Devoted to Raising Children

\[ 1 - \gamma \]

\[ \gamma \]

Subsistence Consumption

Income Expansion Path

\[ \tilde{c} \]

Consumption

\[ c^\gamma (\gamma - 1) \]

Subsistence Consumption

Income Expansion Path

\[ \tilde{c} \]

Consumption

\[ c^\gamma (\gamma - 1) \]
Optimal Investment in Child Quality

\[ e_{t+1} = e( g_{t+1} ) \]
Technological Progress

Technological progress over time

\[ g_{t+1} \equiv \frac{A_{t+1} - A_t}{A_t} = g(e_t, L_t) \]

- \( g(0, L_t) > 0 \)
- \( g_i(e_t, L_t) > 0 \) and \( g_{ii}(e_t, L_t) < 0, \quad i = e, L \)
Population Dynamics

\[ L_{t+1} = n_t L_t \]

\[ L_{t+1} = \begin{cases} 
    n^b(g_{t+1})L_t & \text{if } z_t \geq \tilde{z} \\
    n^a(g_{t+1}, z(e_t, g_t, x_t))L_t & \text{if } z_t \leq \tilde{z}
\end{cases} \]
Dynamics of the Level of Technology and Resources

\[ g_{t+1} = \frac{A_{t+1} - A_t}{A_t} = g(e_t, L_t) \]

\[ A_{t+1} = (1 + g_{t+1})A_t = (1 + g(e_t, L_t))A_t \]

\[ x_{t+1} = \frac{A_{t+1}X}{L_{t+1}} = \frac{(1 + g_{t+1})A_tX}{n_t L_t} = \frac{1 + g_{t+1}}{n_t} x_t = \phi(e_t, g_t, x_t; L_t)x_t \]
The Dynamical System

\[
\{x_t, e_t, g_t, L_t\}_{t=0}^{\infty}
\]

\[
\begin{aligned}
x_{t+1} &= \phi^a(e_t, g_t, x_t; L_t)x_t \\
e_{t+1} &= e(g(e_t; L_t)) \\
g_{t+1} &= g(e_t, L_t) \\
L_{t+1} &= n^a(g(e_t, L_t), z(e_t, g_t, x_t))L_t.
\end{aligned}
\]
The Conditional Evolution of Technology and Education

\[
\{g_t, e_t; L\}_{t=0}^{\infty} \text{ such that:}
\]

\[
g_{t+1} = g(e_t; L)
\]

\[
e_{t+1} = e(g_{t+1})
\]
The Evolution of Education and Technology

\[ g_{t+1} = \frac{e_t + g_t}{1 + \frac{e_t}{L}} \]

\[ e_{t+1} = e(g_{t+1}) \]
The Evolution of Education and Technology

\[ e_{t+1} = e(g_{t+1}) \]
The Evolution of Education and Technology

$$e_{t+1} = e(g_{t+1})$$

$$g_t$$

$$g^L(L)$$

$$e_t$$
The Evolution of Education and Technology

\[ g_t = g'(L) \]

\[ e_{t+1} = e(g_{t+1}) \]

\[ g_{t+1} = g(e_t; L) \]
The Evolution of Education and Technology

\[ g_{t+1} = g(e_t; L) \]

\[ e_{t+1} = e(g_{t+1}) \]
The Evolution of Education and Technology

\[ e_{t+1} = e(g_{t+1}) \]
\[ g_{t+1} = g(e_t; L) \]
The Evolution of Education and Resources Per Worker: Small Population

\[ x_t = \frac{1}{L_x} \left( \lambda E \right)^{\frac{1}{L_x}} \]

Conditional Malthusian Frontier
The Evolution of Education and Resources Per Worker: Intermediate Population

\[ \frac{dx_t}{dt} = \beta \left( x_t - \frac{x_t}{1 + x_t} \right) \]

Conditional Malthusian Frontier
The Evolution of Education and Resources Per Worker: Large Population

\[ x_{t+1} = x_t \]

\[ \hat{e}(L) \]

\[ e^h(L) \]

Conditional Malthusian Frontier
Calibrations of Galor-Weil - (Lagerlof RED 2006)
Testable Implications

- UGT suggests that the transition from stagnation to growth is an *inevitable* by-product of the process of development.

- The inherent Malthusian interaction between technology and population, accelerated the pace of technological progress, and eventually brought an industrial demand for human capital.

- Human capital formation, triggered a demographic transition, enabling economies to convert a larger share of the fruits of factor accumulation and technological progress into growth of income per capita.

- Variations in the timing of the take-off from stagnation to growth contributed significantly to the Great Divergence.
UGT and the Emergence of Convergence Clubs

- Differences in the timing of the take-off from stagnation to growth across countries contributed to the emergence of convergence clubs.

- Although the long-run equilibrium may not differ across economies, differential timing of takeoffs from stagnation to growth segmented economies into three fundamental regimes the differ in their growth structure:
  - Slow growing economies in the vicinity of a Malthusian regime
  - Fast growing countries in a sustained growth regime
  - Economies in the transition from one regime to another
Convergence clubs may be temporary and endogenous forces would permit economies to shift from the Malthusian Regime into the sustained growth regime.

In contrast to existing research that links memberships in each club and the thresholds that permit economies to switch across these regimes to critical levels of income or human capital, UGT suggests that they are in fact associated primarily with critical changes in the rates of technological progress, population growth and human capital formation.
Variations in the economic performance across countries and regions (e.g., earlier industrialization in England than in China) reflect initial differences in geographical factors and historical accidents and their manifestation in variations in institutional, demographic, and cultural factors, trade patterns, colonial status, and public policy.

\[ g_{t+1} = g(e_t, L; \Omega) \]

\[ \Omega = \{ \text{culture, genetic diversity, institutions, trade, colonial history,} \ldots \} \]
Once a technologically-driven demand for human capital emerged in the second phase of industrialization, the prevalence of human capital promoting institutions (i.e. public education), and other factors that affect the return to human capital, determined the extensive-ness of human capital formation, the timing of the demographic transition, and the pace of the transition from stagnation to growth.

\[ e_{t+1} = e(g_{t+1}; \Psi) \]

\[ \Psi = \{ \text{inequality, capital markets, public policy, social structure, trade} \} \]
Variation in Economic Development

\[ e_{t+1} = e(g_{t+1}; \Psi) \]

\[ g_{t+1} = g(e_t, L; \Omega) \]
Earlier Take-Off
Superior Long-Run Equilibrium

\[ e_{t+1} = e(g_{t+1}; \hat{\Psi}) \]

\[ g_{t+1} = g(e_t, L; \hat{\Omega}) \]
Comparative Development: Geographic Determinism

- Culture assimilation vs. cultural diffusion
  - Fosters technological progress within a technological regime on the account of the rapidity of the transitions across regimes

- Concentration of land ownership
  - Delays the implementation of human capital promoting institutions

- International trade
  - Differential effect on the demand for human capital
Comparative Development: Genetic Determinism

- Genetic diversity and comparative development
  - Optimal diversity within a technological regime
Variation in cultural diversity across countries

- Generates variation the timing of the transition from Malthusian stagnation to sustained economic growth:

- Divergence and Reversal of Fortunes
  
  Domination of some societies in the Malthusian era
  Domination of other societies in the transition to industry
The Fundamental Hypothesis

Two forces operate on the degree of cultural diversity within a society:

- **Cultural Assimilation**
  
  Homogenization of cultural traits within a society
  ⇒ fosters the accumulation of society-specific human capital & enhance society’s ability to efficiently exploit the existing technological frontier

- **Cultural Diffusion**

  Diffusion of new (foreign) cultural traits into the society
  ⇒ diminishes the accumulation of society-specific human capital but enhances the creation of knowledge and universal human capital & the adaptability of society toward a looming industrial regime
...The Fundamental Hypothesis

- Within a given technological regime:
  
  An uninterrupted accumulation of society-specific human capital permits efficient production with respect to the PPF and is beneficial for economic prosperity

- In the transition between technological regimes:
  
  The accumulation of universal human capital (knowledge) increases the adaptability of society and facilitates earlier technological transitions
Societies that were geographically vulnerable to cultural diffusion:

- Lagged behind during the agricultural stage of development
- Experienced an earlier transition to industrial society
Cultural Diversity and Malthusian Development

Early stages of development

- The adverse effect of cultural diversity on the transmission of society-specific human capital outweighs its beneficial effect on rural productivity (via the expansion of the knowledge frontier).
- Cultural diversity is associated with an inferior Malthusian equilibrium: lower levels of rural productivity and working population.
- The long-run level of income per capita is unaffected by the degree of cultural diversity since lower level of rural productivity is counter-balanced by a proportionately smaller population.

\[ \Rightarrow \text{Societies that are less vulnerable to cultural diffusion will dominate in the Malthusian stage of development} \]
Later stages of development

- The beneficial effect of moderate level of diversity on the advancement of latent manufacturing productivity outweighs its adverse effect on the transmission of society-specific human capital.
- A higher diversity (at moderate levels) is associated with an earlier take-off to industry.

⇒ Societies that are less vulnerable to cultural diffusion will overtake the more vulnerable ones.
Cultural Composition and Overtaking

The growth rate of (the latent) manufacturing productivity is:

$$g_{t+1} = \omega \left[ (1 - \omega) L_t^\lambda - 1 \right]$$

Consider two societies $C$ and $E$ - society $E$ has a higher cultural diversity in the interval $(0, \omega^*)$
Evolution of the two Countries: Malthusian Regime
Domination of the Culturally Homogenous Country
Domination of the Culturally Homogenous Country
Domination of the Culturally Homogenous Country
Earlier Industrialization: Culturally Diverse Country
Overtaking by the Culturally Diverse Economy
Later Industrialization: Culturally Homogeneous Country
Variation in genetic diversity across countries

- Generates variation the timing of the transition from Malthusian stagnation to sustained economic growth:

- Divergence and Reversal of Fortunes
  
  Domination of some societies in the Malthusian era
  
  Domination of other societies in the transition to industry
The Fundamental Hypothesis

Trade-off associated with genetic diversity:

- **Low Diversity**: fosters the accumulation of society-specific human capital & enhance society's ability to efficiently exploit the existing technological frontier

- **Higher Diverse**: enhances the creation of knowledge and universal human capital & the adaptability of society toward a looming industrial regime

⇒ Hump-shaped relationship between genetic diversity and economic outcomes:
...The Fundamental Hypothesis

- Within a given technological regime:
  
  An uninterrupted accumulation of society-specific human capital permits efficient production with respect to the PPF and is beneficial for economic prosperity.

- In the transition between technological regimes:
  
  The accumulation of universal human capital (knowledge) increases the adaptability of society and facilitates earlier technological transitions.
Societies whose migratory distance from east Africa was small and thus it genetic diversity large (the Serial-Founder effect):

- Lagged behind during the agricultural stage of development
- Experienced an earlier transition to industrial society
Genetic Diversity and Migratory Distance from East Africa

Genetic Diversity and Migratory Distance
HGDP-CEPH Sample of 52 Ethnic Groups

- Expected Heterozygosity
- Migratory Distance from East Africa

- Africa
- Middle East
- Europe
- Asia
- Oceania
- Americas
## Predicted Genetic Diversity and Population Density in 1500 CE

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>(1)</td>
<td>250.99***</td>
<td>-177.40***</td>
<td>1.29***</td>
<td>0.52***</td>
<td>-0.17*</td>
<td>0.19</td>
<td>No</td>
<td>145</td>
<td>0.22</td>
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<tr>
<td>(2)</td>
<td>213.54***</td>
<td>-152.11***</td>
<td>1.05***</td>
<td>0.40***</td>
<td>-0.34***</td>
<td>0.31***</td>
<td>No</td>
<td>145</td>
<td>0.26</td>
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<tr>
<td>(3)</td>
<td>203.02***</td>
<td>-141.98***</td>
<td>1.16***</td>
<td>0.39***</td>
<td>-0.42***</td>
<td>0.26***</td>
<td>No</td>
<td>145</td>
<td>0.38</td>
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<tr>
<td>(4)</td>
<td>195.42***</td>
<td>-137.98***</td>
<td>1.24***</td>
<td>0.39***</td>
<td>-0.42***</td>
<td>0.26***</td>
<td>No</td>
<td>145</td>
<td>0.50</td>
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<td>(5)</td>
<td>199.73**</td>
<td>-146.17***</td>
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<td>0.67</td>
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<td>(6)</td>
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<td>145</td>
<td>0.69</td>
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**Notes:** Bootstrap standard errors in parentheses; *** p < 0.01, ** p < 0.05, * p < 0.1
Genetic Diversity and Population Density in 1500 CE

Genetic Diversity and Population Density in 1500 CE
Adjusted for Transition Timing, Land Productivity, and Continent FE

Log Population Density in 1500 CE (Augmented Component Plus Residuals)
Genetic Homogeneity

Africa  Europe  Asia  Oceania  Americas

Oded Galor
Comparative Economic Development: Insights from Unified Growth Theory
International trade in the early stages of industrialization had an asymmetric effect on:

- the demand for human capital in industrial and non-industrial economies

- timing of the demographic transition in industrial and non-industrial economies

- the pace of the transition from Malthusian stagnation to sustained economic growth
The Main Hypothesis

International trade had an asymmetric effect on DCs and LDCS:

- **Specialization**
  - DCs - in the production of skilled intensive goods
  - LDCs - in the production of unskilled intensive goods

- **Demand for human capital**
  - DCs - a rise the demand for human capital
  - LDCs - a decline in the demand for human capital

- **Demographic Transition**
  - DCs - acceleration of the DT
  - LDCs - delay in the DT
...The Main Hypothesis

- **Gains from Trade**
  
  DCs - channeled towards income per capita  
  LDCs - channeled towards population growth  
  \[ \Rightarrow \] sustained differences in income per capita across countries

- **Dynamics comparative advantage**
  
  DCs - an increase in the abundance in skilled labor  
  LDCs - an increase in the abundance in unskilled labor
The Differential Effect of Trade on Fertility

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Total Fertility Rate (1985-1990)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-OECD</td>
</tr>
<tr>
<td>OLS (1)</td>
<td></td>
</tr>
<tr>
<td>IV (2)</td>
<td></td>
</tr>
<tr>
<td>OLS (3)</td>
<td></td>
</tr>
<tr>
<td>IV (6)</td>
<td></td>
</tr>
</tbody>
</table>

Explanatory Variables:

- ln(Trade/GDP) 1985
  - 0.33** (0.14) | 0.70*** (0.19) | -0.04 (0.09) | -0.13** (0.06)

- ln(GDP/pc) 1985
  - -0.39 (0.27) | -0.44* (0.25) | 0.14 (0.23) | 0.10 (0.23)

- Average Infant Mortality 1985-90
  - 0.03*** (0.005) | 0.03*** (0.005) | 0.03*** (0.005) | 0.03*** (0.006)

- Number of countries
  - 108 | 108 | 24 | 24

- R²
  - 0.72 | 0.71 | 0.62 | 0.60
The Effect of Trade on Total Fertility Rate - Non-OECD
The Transition from Stagnation to Growth

Oded Galor

Comparative Economic Development: Insights from Unified Growth Theory
The Effect of Trade on Education

<table>
<thead>
<tr>
<th>Explanatory Variables:</th>
<th>Non-OECD</th>
<th>OECD</th>
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</thead>
<tbody>
<tr>
<td>ln(Trade/GDP) 1985</td>
<td>OLS (1)</td>
<td>IV (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OLS (3)</td>
</tr>
<tr>
<td>ln(GDP/pc) 1985</td>
<td>0.15** (0.06)</td>
<td>0.20*** (0.07)</td>
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<tr>
<td>Number of countries</td>
<td>74</td>
<td>74</td>
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<tr>
<td>$R^2$</td>
<td>0.05</td>
<td>0.01</td>
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</table>

Dependent Variable: Changes in Education (1985-1990)

Non-OECD

OLS (1)

IV (2)

OECD

OLS (3)

IV (6)
The Effect of Trade on Education - Non-OECD

![Graph showing the relationship between Log Trade Share in GDP 1985 and Education Flow 1985-1990. The graph includes data points for various countries, such as Argentina (ARG), Brazil (BRA), China (CHN), and others. The x-axis represents the log trade share in GDP 1985, while the y-axis represents the education flow from 1985 to 1990. The data points are scattered across the graph, indicating a correlation between trade and education.](image-url)
The Effect of Trade on Education - OECD

Oded Galor

Comparative Economic Development: Insights from Unified Growth Theory

Introduction
Historical Evidence
Uni…ed Growth Theory
The Theory
UGT and Comparative Development
Cultural Diversity
Genetic Diversity
International Trade
Concentration of Land Ownership
Concluding Remarks
Concentration of Land Ownership and the Pace of the Transition from Stagnation to Growth

- In the 2nd phase of industrialization the demand for human capital increased as a by-product of the acceleration in technological progress and generated a growth promoting role for:
  - Human capital formation
  - Human capital promoting institutions

- Investment in human capital was sub-optimal
Concentration of Land Ownership and the Pace of the Transition from Stagnation to Growth

- Lower complementarity between human capital and land vs. physical capital generated conflicts between landowners and capitalists about the level of investment in public schooling.

- Unequal distribution of land was a hurdle for human capital accumulation and economic growth:
  - Delayed education reforms
  - Reduced the skill-intensity of the emerging industrial sector
  - Adversely affected the growth path in the industrial stage
Concentration of Land Ownership and Education Expenditure: US 1900-1940

<table>
<thead>
<tr>
<th>Dependent Variable: Change in log educational expend per child</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>change in land concentration</td>
<td>OLS (1) -2.34*** (0.80)</td>
<td>IV (2) -3.23*** (0.91)</td>
</tr>
<tr>
<td>change in income per capita</td>
<td>0.72*** (0.17)</td>
<td>0.72*** (0.17)</td>
</tr>
<tr>
<td>change in % of the black pop.</td>
<td>-2.90*** (0.96)</td>
<td>-2.58*** (0.92)</td>
</tr>
<tr>
<td>change in % of the urban pop.</td>
<td>-0.66* (0.40)</td>
<td>-0.51 (0.37)</td>
</tr>
<tr>
<td>National time fixed effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.48</td>
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<tr>
<td>First stage F-statistic</td>
<td>13.49</td>
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<tr>
<td>First stage p-value</td>
<td>&lt;0.001</td>
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<tr>
<td>Sargan test p-value</td>
<td>0.27</td>
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</tr>
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</table>
Concentration of Land Ownership and Education Expenditure: US 1900-1940
Unified growth theory provides a meta-theory that naturally encompasses existing hypothesis about the role of geography, institutions, and the composition of human traits, in comparative development and permits that examination of variations the economic performance across countries and regions based on variations initial geographic factors and their manifestation in variations in culture, genetic diversity, scientific structure, and educational, institutional, geographical factors on the pace of the transition from stagnation to growth.