The Malthusian Hypothesis

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Roots of Wealth and Inequality

- The Mystery of Growth:
  - What are the roots of the dramatic improvement in living standards in the past two centuries, after hundreds of thousands of years of stagnation?
- The Mystery of Inequality
  - What is the origin of the vast inequality in income per capita across countries and regions?

Resolution of these Mysteries

- Requires the understanding of the contribution of Malthusian forces to:
  - The transition from stagnation to growth
  - The differential timing of the transition across the globe

The Malthusian Epoch

- Dualism: Stagnation & Dynamism:
  - Stagnation in living standards:
    - Income per capita: fluctuated near the subsistence level
    - Life expectancy: fluctuated in the range of 25-40 years
  - Dynamism (Slow but sizable over 300,000-year period)::
    - Technological progress
    - Population growth
    - Adaptation
  - Malthusian dynamism
    - Ultimately triggered the transition from stagnation to growth

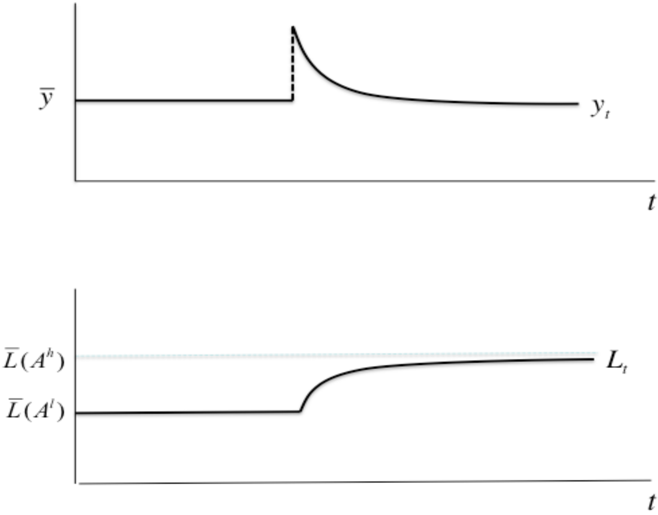
The Malthusian Epoch – Central Characteristics

- Positive effect of income (yield) on the size of population (reduction in child mortality, earlier marriage age; increase fertility)
  - $y \uparrow \Longrightarrow L \uparrow$
- Diminishing returns to labor: (due to land constraint)
  - $L \uparrow \Longrightarrow AP_L \downarrow$

Malthusian Dynamics

- Technological progress during the Malthusian epoch
  - Increases income per capita in the very short-run
    - $A \uparrow \implies y \uparrow$ (above subsistence)
  - Population adjust, as long as income remains above subsistence
    - $y \uparrow \Longrightarrow L \uparrow$
  - Average labor productivity AP_L declines & income per capita ultimately returns to its long-run level
    - $L \uparrow \Longrightarrow AP_L \downarrow \Longrightarrow y \downarrow$
- Technologically advanced economies:
  - Higher population density
  - Similar levels of income per-capita in the long-run

Malthusian Dynamics



The Basic Structure of the Model

- Overlapping-generations economy
- $t = 0, 1, 2, 3...$
- One homogeneous good
- 2 factors of production:
  - Labor
  - Land

Production

- The output produced in period t

$$Y_t = (AX)^{\alpha} L_t^{1-\alpha} \qquad 0 < \alpha < 1$$

  - $L_t \equiv$ working population (labor) in period t
  - $X \equiv$ land
  - $A \equiv$ technological level
  - $AX \equiv$ effective resources

- Output per worker produced at time t

$$y_t = \frac{Y_t}{L_t} = \left[\frac{AX}{L_t}\right]^{\alpha}$$

Supply of Factors of Production

- Land is fixed over time
  - Surface of planet earth
- Labor evolves endogenously
  - Determined by households' fertility rate

Individuals

- Live for 2 period
    - Childhood: (1st Period):
        - Passive economic agents
        - Consume fixed amount of their parental resources
    - Adulthood (2nd Period):
        - Work
        - Allocate income between consumption and children

Preferences and Budget Constraint

- Preferences of an adult at time t

$$U_t = (n_t)^{\gamma}(c_t)^{1-\gamma}. \qquad 0 < \gamma < 1$$

  - $n_t \equiv$ number of children of individual t
  - $c_t \equiv$ consumption of individual t
  - $\gamma \equiv$ predisposition towards children

- Budget constraint:

$$\rho n_t + c_t \leq y_t$$

  - $\rho \equiv$ cost of raising a child

Optimization

- Since the utility function is homothetic
  - Fraction $(1-\gamma)$ of income is spent on consumption
  - Fraction γ of income is spent on children
- Optimal expenditure on consumption and children

$$c_t = (1-\gamma)y_t$$

$$\rho n_t = \gamma y_t$$

- Desirable number of children

$$n_t = \frac{\gamma}{\rho} y_t$$

Population Dynamics

- The evolution of the size of the working population

$$L_{t+1} = n_t L_t$$

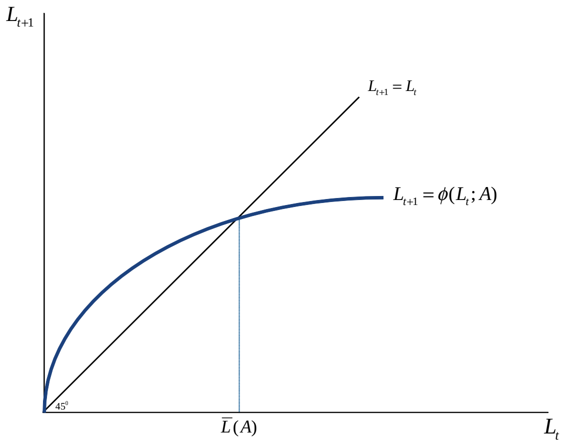
where

$$n_t = \frac{\gamma}{\rho} y_t$$

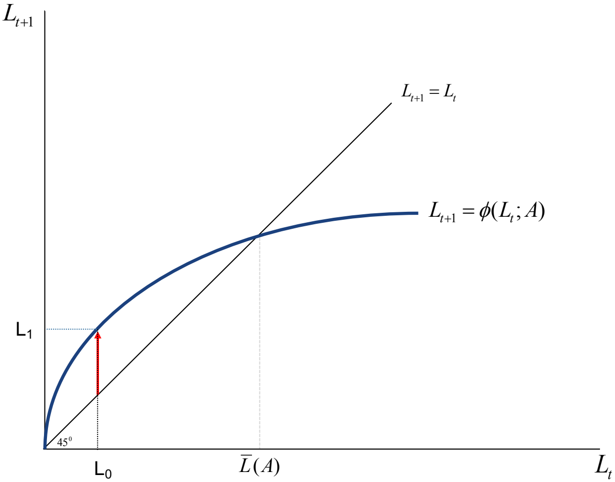
- Population dynamics:

$$L_{t+1} = \frac{\gamma}{\rho} y_t L_t = \frac{\gamma}{\rho} Y_t = \frac{\gamma}{\rho} (AX)^{\alpha} L_t^{1-\alpha} \equiv \phi(L_t; A)$$

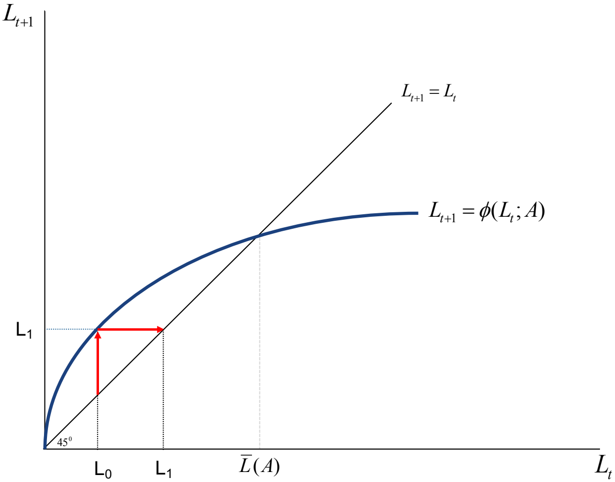
Population Dynamics – Phase Diagram



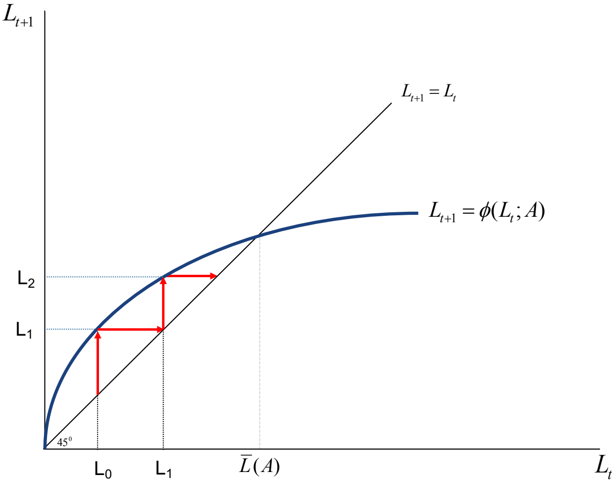
Population Dynamics



Population Dynamics



Population Dynamics



The Steady-State Level of Population

- The evolution of the size of the working population

$$L_{t+1} = \frac{\gamma}{\rho}(AX)^{\alpha} L_t^{1-\alpha} \equiv \phi(L_t; A)$$

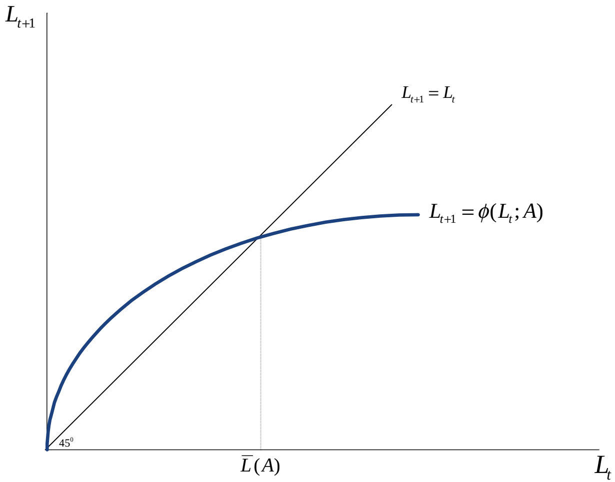
- Steady-State: $L_{t+1} = L_t = \bar{L}$

$$\bar{L} = \frac{\gamma}{\rho}(AX)^{\alpha} \bar{L}^{1-\alpha}$$

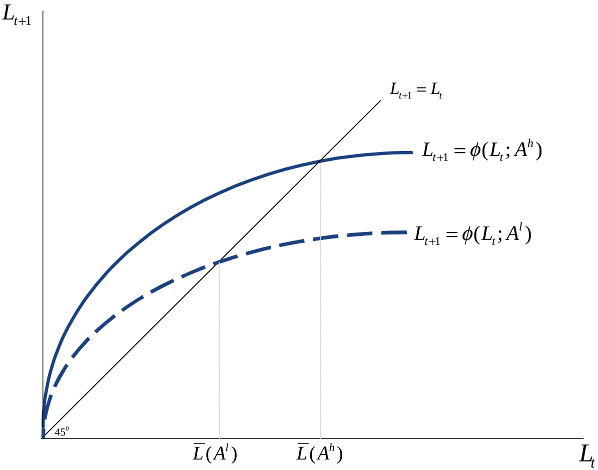
- The steady-state level of the size of the working population

$$\bar{L} = (\frac{\gamma}{\rho})^{1/\alpha}(AX) \equiv \bar{L}(A)$$

Population Dynamics



Adjustment of Population to Advancements in Technology



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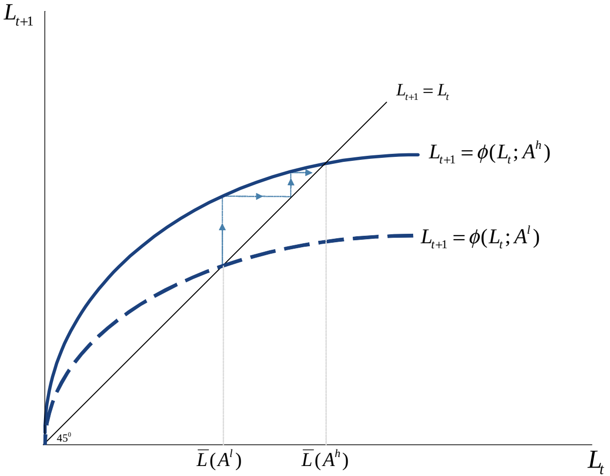


The Evolution of Income per Worker

- The time path of income per worker

$$y_{t+1} = \left[\frac{AX}{L_{t+1}}\right]^{\alpha} = \left[\frac{AX}{n_t L_t}\right]^{\alpha} = \frac{y_t}{n_t^{\alpha}}$$

where

$$n_t = \frac{\gamma}{\rho} y_t$$

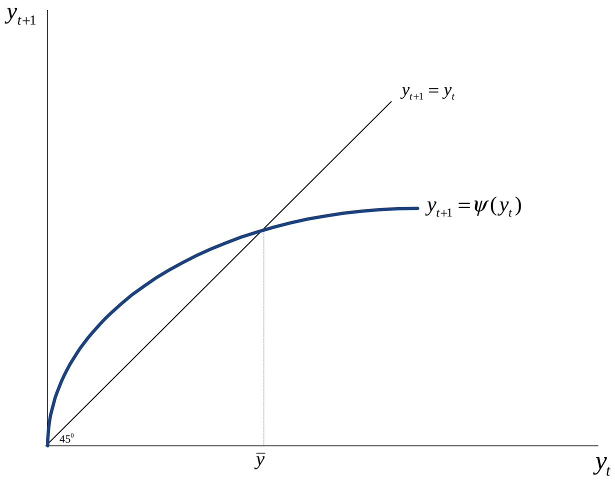
$\Longrightarrow$

$$y_{t+1} = \frac{y_t}{n_t^{\alpha}} = \frac{y_t}{\left[\frac{\gamma}{\rho}\right]^{\alpha} y_t^{\alpha}}$$

- Dynamics of income per worker

$$y_{t+1} = \left[\frac{\rho}{\gamma}\right]^{\alpha} y_t^{1-\alpha} \equiv \psi(y_t)$$

The Evolution of Income per Worker – Phase Diagram



The Steady-State Level of Income per Worker

- The time path of income per worker

$$y_{t+1} = \left[\frac{\rho}{\gamma}\right]^{\alpha} y_t^{1-\alpha}$$

- Steady-State $y_{t+1} = y_t = \bar{y}$

$$\bar{y} = \left[\frac{\rho}{\gamma}\right]^{\alpha} \bar{y}^{1-\alpha}$$

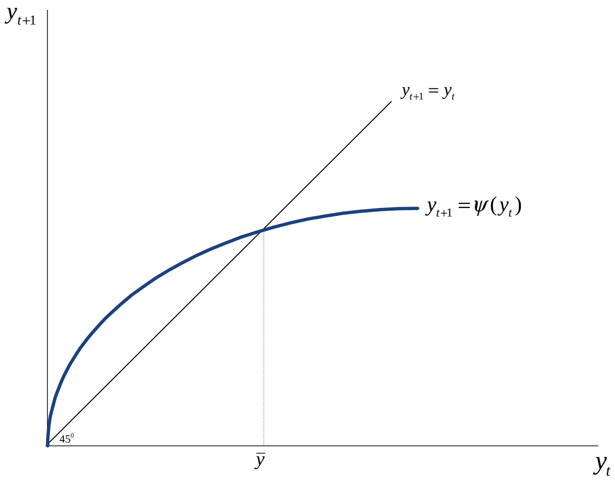
- The steady-state level of income per worker

$$\bar{y} = \left[\frac{\rho}{\gamma}\right]$$

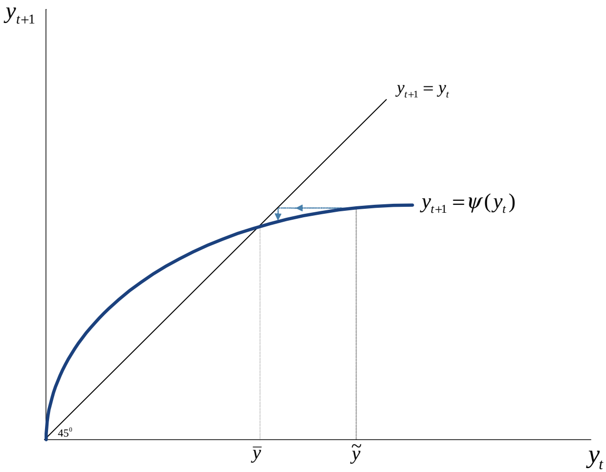
- The steady-state level of fertility

$$\bar{n} = \frac{\gamma}{\rho}\bar{y} = \left[\frac{\gamma}{\rho}\right]\left[\frac{\rho}{\gamma}\right] = 1$$

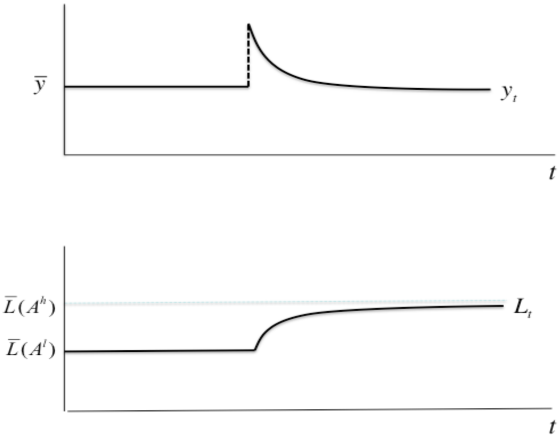
The Evolution of Income per Worker



The Effect of Technological Advancement on income per Worker



Technological Progress and the Time Path of Population & Income



Testable Predictions

- Technological progress:
  - Higher population density
  - No effect on income per-capita in the long-run
- Higher land quality:
  - Higher population density
  - No effect on income per-capita in the long-run
- Lower predisposition towards children or higher cost of children:
  - Higher income per capita in the the Malthusian steady-state

Malthusian Dynamics - Prominent Examples

- The dynamics of Irish economy (1600 - 1850)
  - Triggered by the adoption of a new world crop – potato
- The dynamics of the Chinese Economy (1500 - 1910)
  - Triggered by superior agricultural technology & adoption of maize
- The dynamics of the English economy (1348 - 1635)
  - Triggered by the Black Death

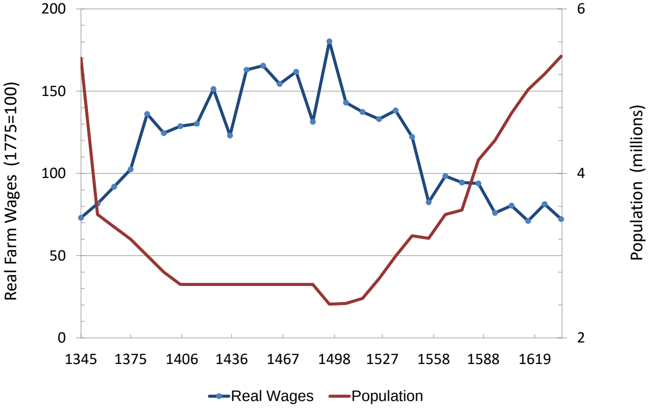
Malthusian Dynamics - Ireland (1600 - 1850)

- The Colombian Exchange $\Longrightarrow$ massive cultivation of potato post-1650
  - 1600-1841
    - Population grew from 1.4 to 8.2 million
    - Income per capita increased only very modestly
  - 1845-1852 Potato blight destroys crops $\Longrightarrow$ Great Famine
    - Population declined by about 2 million (Death & Emigration)
    - Income per capita remained nearly unchanged

Malthusian Dynamics - China (1500 - 1910)

- Superior agricultural technology
  - 1500-1820
    - Population increased from 103 to 381 million
    - Share of China in world population increased from 23% to 37%
    - Income per capita was steady at $600
- Adoption of Maize
  - 1776-1910
    - Contributed to 1/5 of China's population growth over the period
    - No impact on income per capita

Malthusian Adjustments to the Black Death: England, 1348–1635



Length of the Malthusian Adjustment Period

- Black Death:
  - 300 years
- 1609 Spanish expulsion of 300K converted Muslims (Moriscos):
  - 180 years (Chaney and Hornbeck, EJ 2016)

Empirical Analysis: Objective

- Confirm (or refute) the Malthusian hypothesis:
  - The *causal* effect of technology on population
  - The absence of an effect of technology on long-run income per capita
- Cannot rely on a *correlation* between technology & population:
  - Correlation $\not\Rightarrow$ Malthusian impact of technology on population
    - May reflect the impact of population on technology
    - A third factor that affect both population & technology

Correlation vs Causation - Examples

- Correlation $\not\Rightarrow$ Causation
  - Reverse Causality
  - Omitted Variables
- Reverse Causality (Example):
  - Correlation between: [overweight people] & [people on diet]
    - Diet $\Rightarrow$ Overweight ?
    - Overweight $\Longrightarrow$ Diet
- Omitted Variables – 3rd factor governs the correlation (Example):
  - Correlation between: [ice cream consumption] & [# drowning]
    - [ice cream consumption↑] $\Rightarrow$ [# drowning↑] ?
    - [Temperature↑] $\begin{cases} \Rightarrow & \text{[ice cream consumption} \uparrow\text{]} \\ \Rightarrow & \text{[swimming} \uparrow\text{]} \Rightarrow \text{[people drowning} \uparrow\text{]} \end{cases}$

Cross-Country Analysis

- Available Data
  - Dependent Variables:
    - Income per capita (y) in the years 1, 1000, 1500
    - Population density (PD) in the years 1, 1000, 1500
  - Main Independent Variables:
    - Technological level (A) in the years 1000 BCE, 1, 1000, 1500
    - Land Productivity
- Empirical hurdle:
  - A_{1500} cannot be used to identify the effect of tech on y_{1500} & PD_{150}
    - y_{1500} may affect A_{1500} (reverse causality)
    - PD_{1500} may affect A_{1500} (reverse causality)

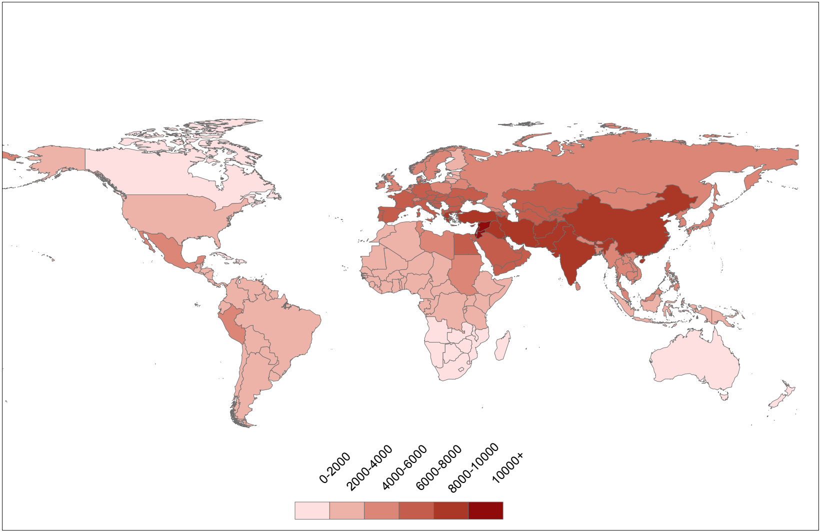
Identification Strategy

- Search for exogenous sources of cross-country variation in technological level
- Historical origins of variation in technological level across countries
  - Use the differential onset of the *Neolithic Revolution* across the globe
    - Predictor of the technological level thousands of years later

The Neolithic (Agricultural) Revolution (NR)

- The transition from hunter-gatherer tribes to agricultural communities
  - Emergence of non-food-producing class:
    - $\Longrightarrow$ Knowledge creation (science, technology & written languages)
    - $\Longrightarrow$ Technological head start
    - $\Longrightarrow$ Persistence of this technological edge
- Variations in the timing of the NR:
  - $\Longrightarrow$ Origins of variations in the technological level across the globe

Variation in the Onset of the Neolithic Revolution



The Neolithic Revolution

- Origins
  - Population pressure
  - Biodiversity
  - Climatic changes
- Global Variations in the onset of agriculture
  - Availability of domesticable species of plants & animals
  - Orientation of the continents

Homo Sapiens in Cradle of Humankind in Africa

For over hundred thousand years Homo sapiens remained in Africa

- Roamed in small bands of hunter-gatherers
- Developed better technological capabilities
- Became more effective hunters
    - Resource expansion
        - $\Longrightarrow$ Increase in the size of the human population
        - $\Longrightarrow$ Reduction in living space & natural resources per person
        - $\Longrightarrow$ A search for additional fertile living spaces

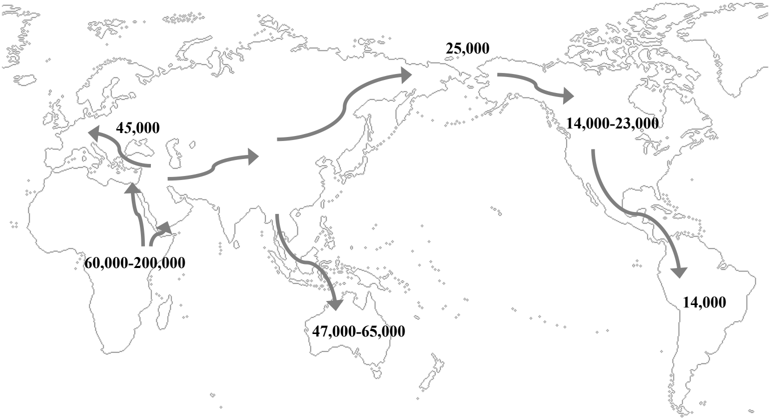
The Exodus of Home Sapiens out of Africa

- Multiple dispersals:
- 200K years BP – Early migration of Homo sapience
  - Oldest fossils of Homo sapiens in Euroasia:
    - 177-194K BP – Misliya Cave (Mt. Carmel, Israel)
    - 210K BP – Apidima Cave (Greece)
  - Descendants of these initial migrants, either:
    - Became extinct, due to small population size:
    - Retreated back to Africa, due to adverse climatic conditions
- As early as 60-90K years BP – major wave of migration
  - Descendants of these wave of migrants populated plant Earth
    - Humans descend from *Mitochondrial Eve* (lived in Africa 150K BP)

Population Expansion

- Humans branched out of Africa in bands of hunter-gatherers
  - Settled new ecological niches
  - Developed new technological capabilities
  - Became skilled hunters
    - $\Longrightarrow$ Significant increase in the size of the human population
  - As long as new ecological niches were available
    - Human multiply rapidly without reducing resources per capita

Out of Africa - Major Migration Wave of Homo Sapiens



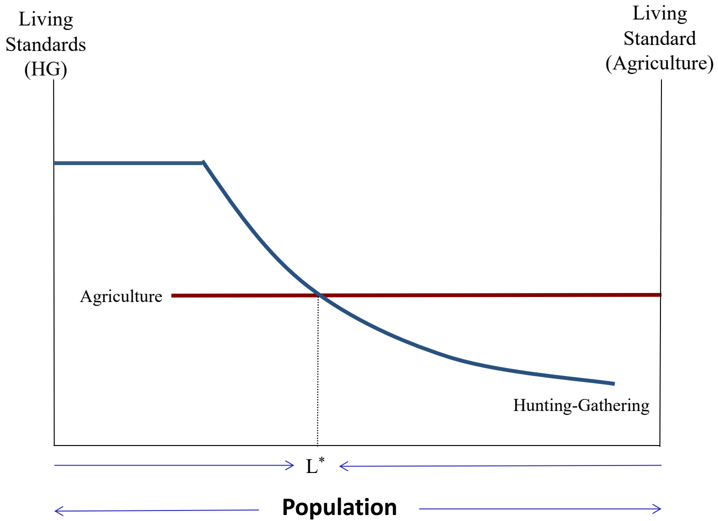
Population Pressure – Gradual Decline in Living Standards

- Population growth led to scarcity of virgin ecological niches
  - Hunter-Gatherers tribes competed over fewer wild animals & plants
  - Living standards gradually declined, despite technological advances
    - $\Longrightarrow$ Search for alternative modes of subsistence
  - Acre of fertile land could feed 100 X more farmers than hunter-gatherers
    - $\Longrightarrow$ Transition to agriculture

Agriculture – "The Worst Mistake in the History of Humanity"?

- Evidence from prehistoric human skeletons:
  - Deteriorating health and economic conditions in the transition from hunting-gathering to sedentary agriculture
  - Hunter-gatherers *(millennia before the transition to agriculture)*:
    - Lived longer
    - Ate better
    - Worked less intensely
    - Suffered from fewer infectious diseases
  - Origins of the myth of a lost paradise? (common to many cultures across the world)
- Why did early farmers and shepherds abandon the relatively superior life of hunting & gathering?

The Transition to Agriculture – Rational & Inevitable Decision



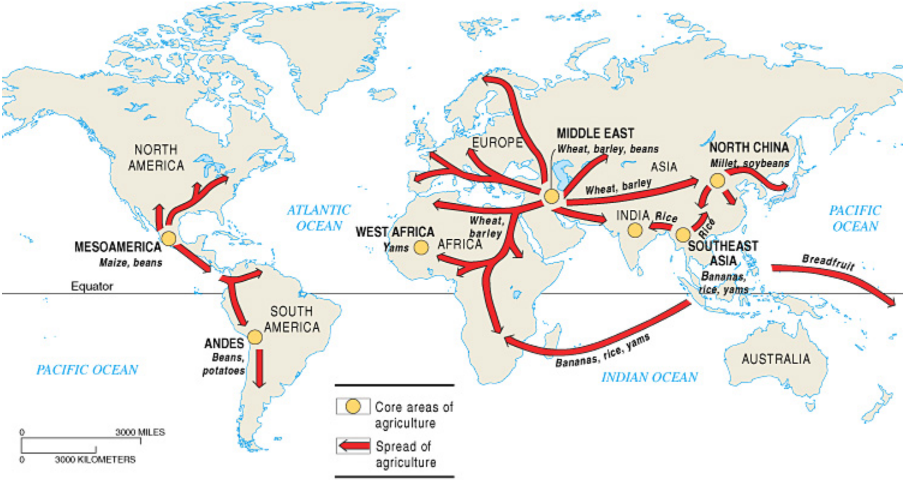
Climate Change

- The end of the last ice age – 11,700 years ago
  - Land became more suitable for agriculture
  - Climatic volatility and seasonality increased
    - Yield from HG became scarcer & less predictable
    - Farming became a safer strategy of food production

Biogeographical Origins of the Onset of the Neolithic Revolution

- Geographical factors conducive for biodiversity (climate, latitude, landmass)
  - Availability of domesticable species of plants and animals
    - $\Longrightarrow$ Onset of domestication
- Orientation of continents:
  - $\Longrightarrow$ Diffusion of agricultural practices along similar latitudes

Emergence & Spatial Diffusion of the Neolithic Revolution



Origins of Global Variations

- Earlier Neolithic Revolution in Euro-Asia reflects:
  - Geographical factors conducive for biodiversity (climate, latitude, landmass)
    - Largest number of domesticable species of plants & animals
  - East-West orientation
    - Diffusion of agricultural practices along similar latitudes
  - Lack of geographical barriers
    - Sahara desert (Africa); Impassable rainforest (Central America)

Regional Variation in the Domestication of Plants & Animals

- Fertile Crescent:
  - Wheat, barley, peas, chickpeas, olives, figs, dates
  - Sheep, goats, pigs, and pigeons
- South East Asia & China
  - Rice
  - Buffalo, ducks & silkworms
- Indian Subcontinent
  - Sesame & aubergines
  - Zebus
- Africa
  - Sorghum, yams & coffee
  - Donkeys
- The Americas
  - Maize, beans, squash, potatoes
  - Turkeys, llamas and alpacas

The Diamond Hypothesis

- The domination of Euro-Asia in the pre-colonial era reflects:
  - Larger number of domesticable species of plants and animals
  - East-West orientation
    - $\Longrightarrow$ Technological head start & its persistent effect on development
- Earlier onset of the Neolithic Revolution:
  - Technological superiority throughout human history

The Malthusian Hypothesis - Identification Strategy I

- Avoiding reverse causality:
  - Use the predicted level of technology (not the actual one)
    - Based on the time elapsed since the Neolithic Revolution (NR)
  - But is the time elapsed since the NR indeed a good predictor of the technological level thousands of years later?
    - e.g., in the years 1000BCE, 1CE, 1500CE

Basic Empirical Model - Impact of the Neolithic Revolution on Technology

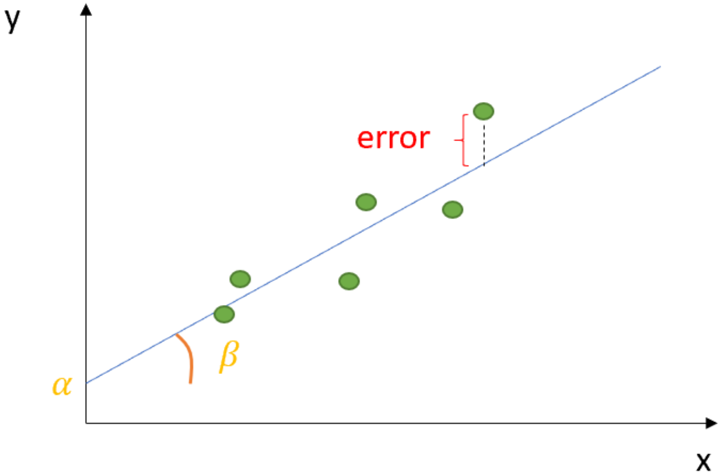
$$\ln T_{i,t} = \beta_{0,t} + \beta_{1,t} \ln NR_i + \varepsilon_{i,t}$$

- $T_{i,t} \equiv$ Technological level of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
- $\varepsilon_{i,t} \equiv$ error term of country i in year t
  - Prediction:

$$\beta_{1,t} > 0$$

  - Relevant columns: 1, 3, 5:

Ordinary Least Squares (OLS) Regressions



The Neolithic Revolution & Technological Level: 1000 BCE–1500 CE

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
	Log Technological Level					
	1000 BCE		1 CE		1500 CE	
Log years since Neolithic	**0.72***** (0.06)	**0.47***** (0.12)	**0.56***** (0.06)	**0.28**** (0.12)	**0.74***** (0.06)	**0.34**** (0.10)
Geographical Controls	No	Yes	No	Yes	No	Yes
Continental dummies	No	Yes	No	Yes	No	Yes
Observations	112	112	134	134	134	134
Adjusted R^2	0.51	0.60	0.31	0.63	0.55	0.82

Notes: Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Augmented Empirical Model - Impact of the NR on Technology

$$\ln T_{i,t} = \beta_{0,t} + \beta_{1,t} \ln NR_i + \beta_{2,t} \ln G_i + \beta_{3,t} D_i + \varepsilon_{i,t}$$

- $T_{i,t} \equiv$ Technological level of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
- $G_i \equiv$ vector of geographical controls for country i
- $D_i \equiv$ continental fixed effect for country i

    - Prediction:

$$\beta_{1,t} > 0$$

    - Relevant columns: 2, 4, 6:

The Neolithic Revolution & Technological Level: 1000 BCE–1500 CE

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
	Log Technological Level					
	1000 BCE		1 CE		1500 CE	
Log years since Neolithic	**0.72***** (0.06)	**0.47***** (0.12)	**0.56***** (0.06)	**0.28**** (0.12)	**0.74***** (0.06)	**0.34**** (0.10)
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The Malthusian Hypothesis - Identification Strategy II

- Mitigating concerns that a third factor (e.g., ability) governed the relationship between [PD & y] & [NR]
  - Search for Instrumental Variable(s) Z for the timing of the NR, i.e.,
    - Affected the timing of the NR
    - Affected population density (PD) only through the NR timing

$$Z \Rightarrow NR \Rightarrow PD$$

The Malthusian Hypothesis - Identification Strategy II

- IV for the NR timing:
  - Number of prehistoric domesticable species of plants & animals
- Identifying Assumption:
  - Prehistoric plants & animals affected *PD* only via the NR timing

The Basic Empirical Model - Impact of Technology on Population Density

$$\ln PD_{i,t} = \alpha_{0,t} + \alpha_{1,t} \ln NR_{i,t} + \alpha_{4,t}^{'} D_i + \delta_{i,t}$$

- $PD_{i,t} \equiv$ Population density of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
- $D_i \equiv$ continental fixed effect for country i
- $\delta_{i,t} \equiv$ error term of country i in year t
  - Prediction:

$$\alpha_{1,t} > 0$$

  - Relevant columns: 1:

Determinants of Population Density in 1500 CE

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	IV
	Log population density in 1500 CE					
Log years since Neolithic	**0.833*** (0.298)**		**1.025*** (0.223)**	**1.087*** (0.184)**	**1.389*** (0.224)**	**2.077*** (0.391)**
Log land productivity		**0.587*** (0.071)**	**0.641*** (0.059)**	**0.576*** (0.052)**	**0.573*** (0.095)**	**0.571*** (0.082)**
Log absolute latitude		-0.425*** (0.124)	-0.353*** (0.104)	-0.314*** (0.103)	-0.278** (0.131)	-0.248** (0.117)
Distance to nearest coast or river				-0.392*** (0.142)	0.220 (0.346)	0.250 (0.333)
% land within 100 km of coast or river				0.899*** (0.282)	1.185*** (0.377)	1.350*** (0.380)
Continental dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147	147	147	147	96	96
R^2	0.40	0.60	0.66	0.73	0.73	0.70
First-stage F-statistic						14.65
Overidentification Test (p-value)						0.44

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Augmented Empirical Model - Impact of Technology on Population Density

$$\ln PD_{i,t} = \alpha_{0,t} + \alpha_{1,t} \ln NR_{i,t} + \alpha_{2,t} \ln X_i + \alpha'_{3,t} G_i + \alpha'_{4,t} D_i + \delta_{i,t}$$

- $PD_{i,t} \equiv$ Technological level of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
- $X_i \equiv$ measure of land productivity for country i
- $G_i \equiv$ vector of geographical controls for country i
- $D_i \equiv$ continental fixed effect for country i

  - Predictions:

$$\alpha_{1,t} > 0 \qquad \alpha_{2,t} > 0$$

  - Relevant columns: 2-4:

Determinants of Population Density in 1500 CE

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	IV
	Log population density in 1500 CE					
Log years since Neolithic	**0.833***** **(0.298)**		**1.025***** **(0.223)**	**1.087***** **(0.184)**	**1.389***** **(0.224)**	**2.077***** **(0.391)**
Log land productivity		**0.587***** **(0.071)**	**0.641***** **(0.059)**	**0.576***** **(0.052)**	**0.573***** **(0.095)**	**0.571***** **(0.082)**
Log absolute latitude		-0.425*** (0.124)	-0.353*** (0.104)	-0.314*** (0.103)	-0.278** (0.131)	-0.248** (0.117)
Distance to nearest coast or river				-0.392*** (0.142)	0.220 (0.346)	0.250 (0.333)
% land within 100 km of coast or river				0.899*** (0.282)	1.185*** (0.377)	1.350*** (0.380)
Continental dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147	147	147	147	96	96
R^2	0.40	0.60	0.66	0.73	0.73	0.70
First-stage F-statistic						14.65
Overidentification Test (p-value)						0.44

Notes: Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The Basic Empirical Model - Impact of Technology on Income per Capita

$$\ln y_{i,t} = \beta_{0,t} + \beta_{1,t} \ln NR_{i,t} + \varepsilon_{i,t}$$

- $y_{i,t} \equiv$ income per capita of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
    - Prediction:

$$\beta_{1,t} = 0$$

Augmented Empirical Model - Impact of Technology on Income per Capita

$$\ln y_{i,t} = \beta_{0,t} + \beta_{1,t} \ln NR_{i,t} + \beta_{2,t} \ln X_i + \beta'_{3,t} G_i + \beta'_{4,t} D_i + \varepsilon_{i,t}$$

- $y_{i,t} \equiv$ income per capita of country i in year t
- $NR_i \equiv$ years elapsed since the onset of agriculture in country i
- $X_i \equiv$ measure of land productivity for country i
- $G_i \equiv$ vector of geographical controls for country i
- $D_i \equiv$ continental fixed effect for country i

    - Predictions:

$$\beta_{1,t} = 0 \qquad \beta_{2,t} = 0$$

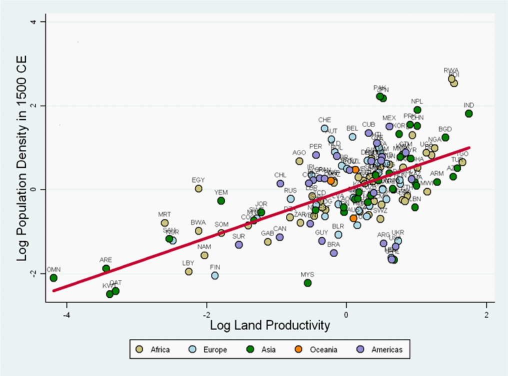
    - Relevant columns: 1-3:

Effects on Population Density vs Income per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
	Log Income Per Capita in			Log Population Density in		
	1500 CE	1000 CE	1 CE	1500 CE	1000 CE	1 CE
Log years since Neolithic	**0.159** (0.136)	**0.073** (0.045)	**0.109** (0.072)	**1.337**** (0.594)	**0.832**** (0.363)	**1.006**** (0.483)
Log land productivity	**0.041** (0.025)	**-0.021** (0.025)	**-0.001** (0.027)	**0.584***** (0.159)	**0.364***** (0.110)	**0.681**** (0.255)
Log absolute latitude	-0.041 (0.073)	0.060 (0.147)	-0.175 (0.175)	0.050 (0.463)	-2.140** (0.801)	-2.163** (0.979)
Distance to nearest coast or river	0.215 (0.198)	-0.111 (0.138)	0.043 (0.159)	-0.429 (1.237)	-0.237 (0.751)	0.118 (0.883)
% land within 100 km of coast or river	0.124 (0.145)	-0.150 (0.121)	0.042 (0.127)	1.855** (0.820)	1.326** (0.615)	0.228 (0.919)
Continental dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31	26	29	31	26	29
R^2	0.66	0.68	0.33	0.88	0.95	0.89

Notes: Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$

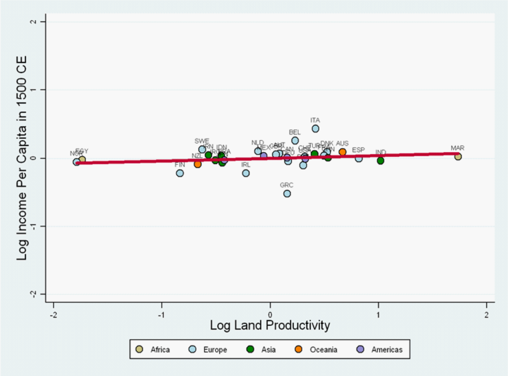
Land Productivity and Population Density in 1500



Conditional on transition timing, geographical factors, and continental fixed effects

Source: Ashraf-Galor (AER 2011)

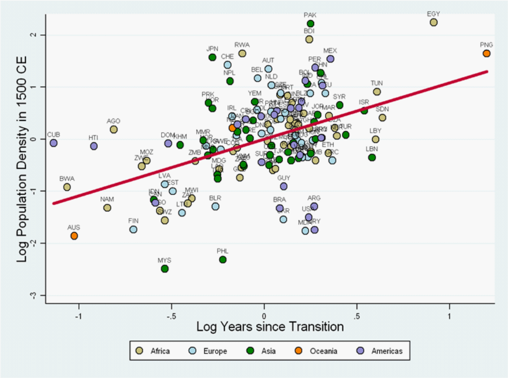
Land Productivity and Income per Capita in 1500



Conditional on transition timing, geographical factors, and continental fixed effects.

Source: Ashraf-Galor (AER 2011)

Technology and Population Density in 1500

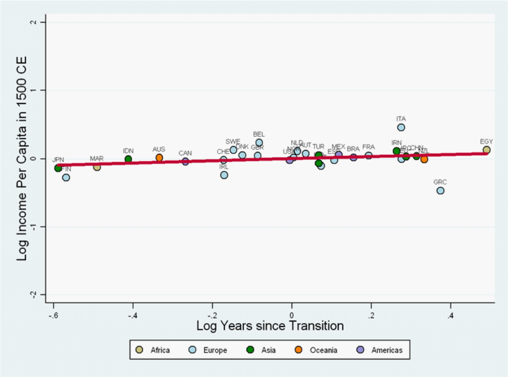


Years elapsed since the Neolithic Transition is a proxy for technological levels in 1500.

Conditional on land productivity, geographical factors, and continental fixed effects.

Source: Ashraf-Galor (AER 2011)

Technology and Income per Capita in 1500



Years elapsed since the Neolithic Transition is a proxy for technological levels in 1500.

Conditional on land productivity, geographical factors, and continental fixed effects.

Source: Ashraf-Galor (AER 2011)