Human Evolution and Economic Development

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    - Stimulated the take-off from an epoch of stagnation to sustained growth

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  - Moderate fecundity (Galor-Klemp, 2015)

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- Genetic loci associated with immunity, pigmentation and height
  - Strong positive selection since the Neolithic transition (Mathieson et al., 2015)

The Benchmark Model – Galor-Moav (QJE 2002)

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- 2 factors of production:

    - Labor (measured in efficiency units)
    - Land

Factor Supply

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- Efficiency units of labor evolves endogenously
  - Determined by households' decisions about the number and level of human capital of their children

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- Triggers of the Demographic Transition

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- Output per capita fluctuates (with a negligible trend) around a constant level in the long-run

  - Reflecting diminishing returns to labor & positive effect of income on population

Production

- The output produced in period t

$$Y_t = H_t^{1-\alpha}(A_t X)^\alpha$$

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  - $A_t \equiv$ technological level
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- Output per efficiency units of labor at time t

$$y_t = x_t^\alpha$$

  - $x_t \equiv (A_t X)/H_{tt} \equiv$ effective resources per worker

The Malthusian Structure – Effects of Technological Progress

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- Long-run (population reaches a new steady-state):
  - $L_t \uparrow \implies y \downarrow$ (back to $\bar{y}$)

Sources of Technological Progress

- Average individuals' quality affects technological progress

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  - human capital provides an advantage in adopting and advancing new technologies

Technological Progress

$$g_{t+1} \equiv \frac{A_{t+1} - A_t}{A_t} = \psi(e_t)$$

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$$\psi'(e_t) > 0; \quad \psi''(e_t) < 0; \quad \psi(0) = 0$$

- The average quality of the population has a positive and diminishing effect on technological progress
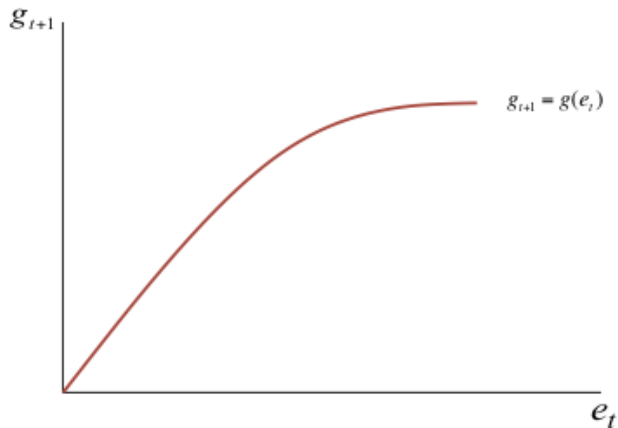
Technological Progress

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

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Human capital of an individual who joins the labor force in period $t + 1$

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- $h(0, g) > 0$

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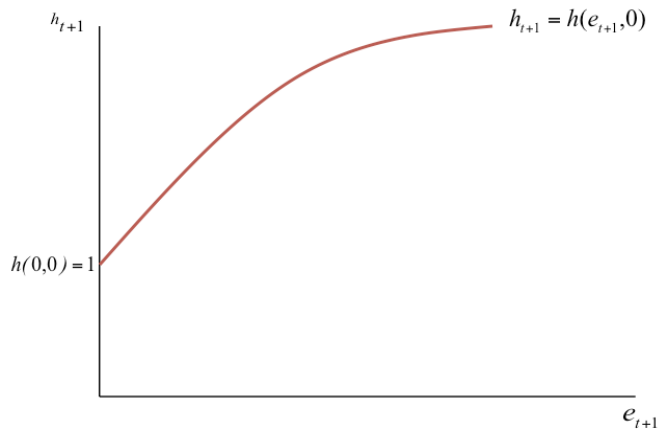
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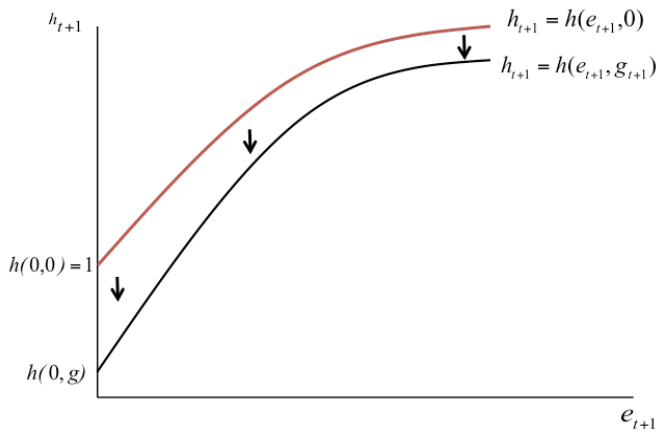
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    - Population growth declines & human capital formation increases further

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- Evolution
  - Changes in the composition of types

Preferences

- The utility function of a member i of generation t (adults at time t)

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- Intergenerational transmission of predisposition towards quality

$$\beta_{t+1}^i = \beta_t^i = \beta^i$$

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    - Consumption above subsistence assure that survival of the parent & lineage

Budget and Subsistence Consumption Constraints

$$w_t h_t^i n_t^i (\tau + e_{t+1}^i) + c_t^i \leq w_t h_t^i \equiv z_t^i$$

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- Subsistence consumption constraint:

$$c_t \geq \tilde{c}$$

Constraint and Optimization

Optimal Investment in Child Quality of the Qantity type
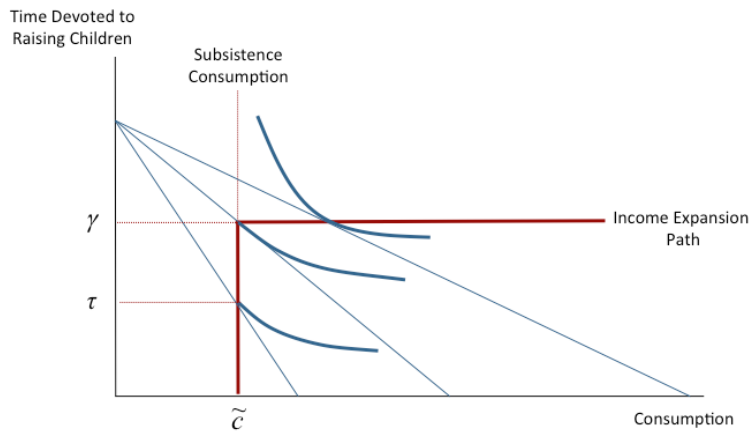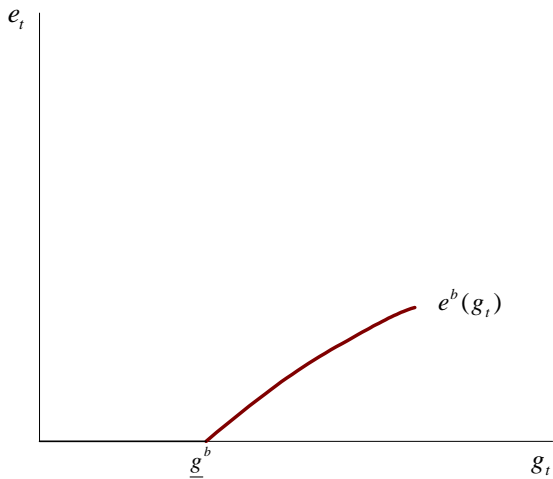
Optimal Investment in Child Quality of the Quality type
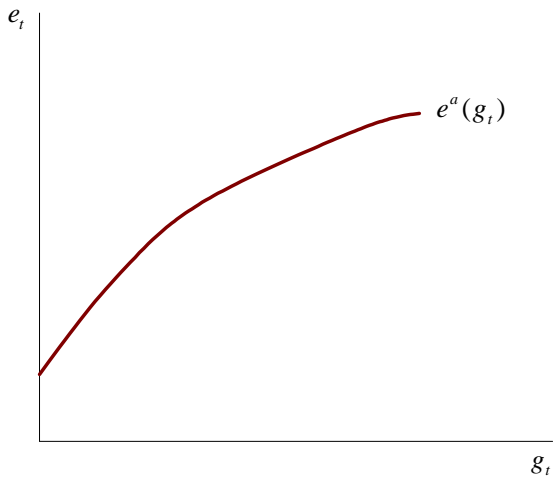
Optimal Investment in Child Quality - Quality type - and Qantity type

e_t

$e^a(g_t)$

$e(g_t; q) = q e^a(g_t) + (1-q)e^b(g_t)$

$e^b(g_t)$

$\underline{g}^b$

g_t
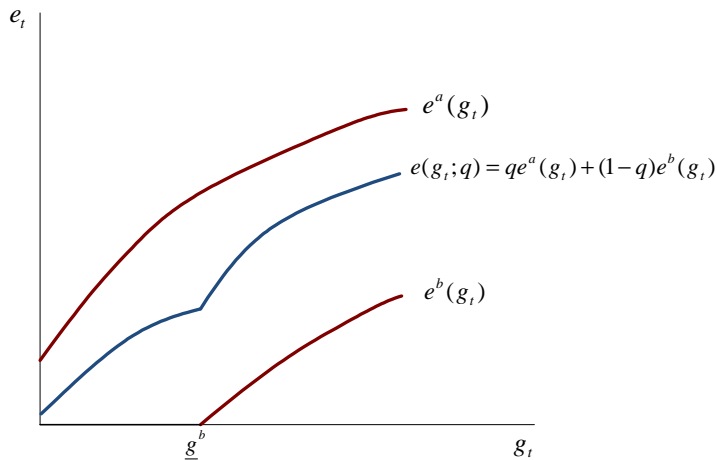
Optimization – Malthusian Epoch
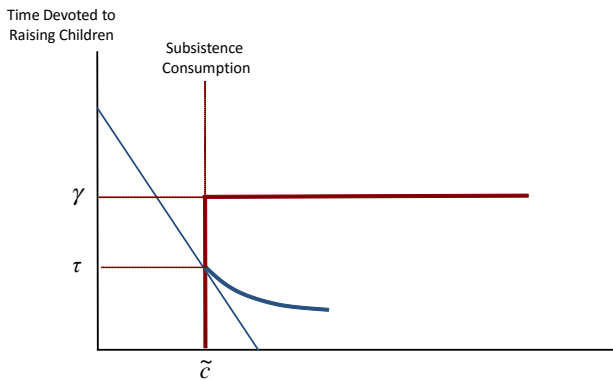
Evolutionary Advantage of the Quality Type
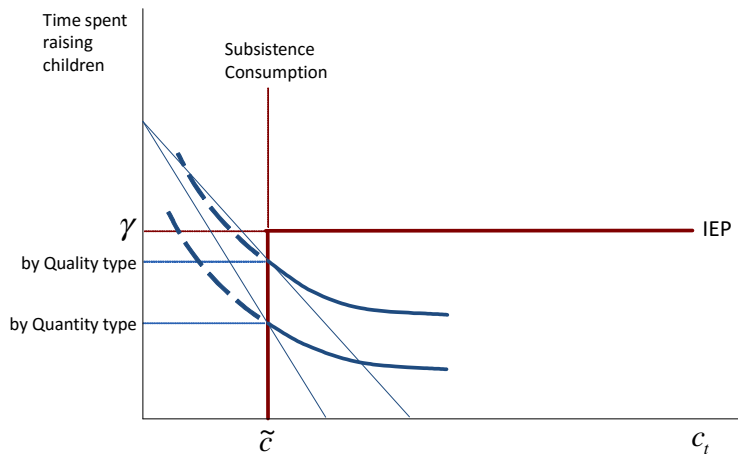
Differential Fertlity Across Types
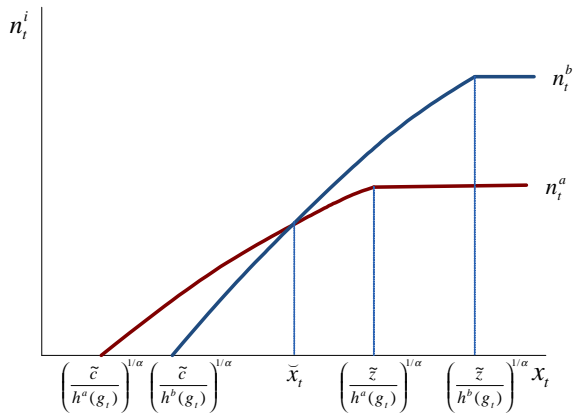
The Dynamical System

A sequence $\left\{x_t, g_t, e_t, q_t\right\}_{t=0}^{\infty}$ such that:

$$
\begin{cases}
x_{t+1} = x(g_t, x_t, q_t) \\
q_{t+1} = q(g_t, x_t, q_t) \\
g_{t+1} = \psi(e_t) \\
e_t = e(g_t, q_t)
\end{cases}
$$

The Conditional Evolution of Technology and Education

$\{g_t, e_t; q\}_{t=0}^{\infty}$ such that for all t

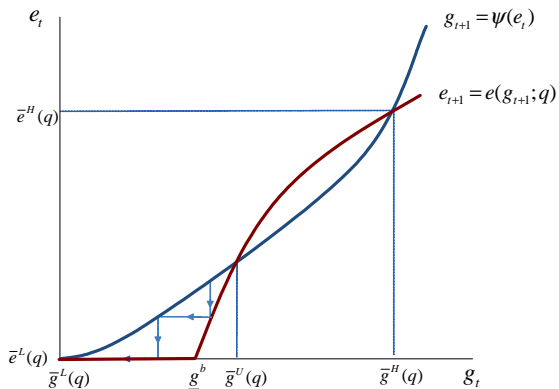$$\begin{cases} e_t = e(g_t; q) \\ g_{t+1} = \psi(e_t). \end{cases}$$
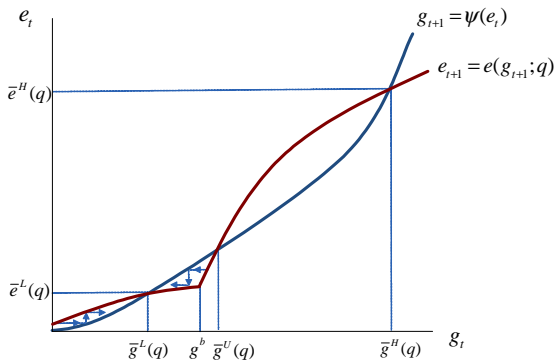
Technological Progress
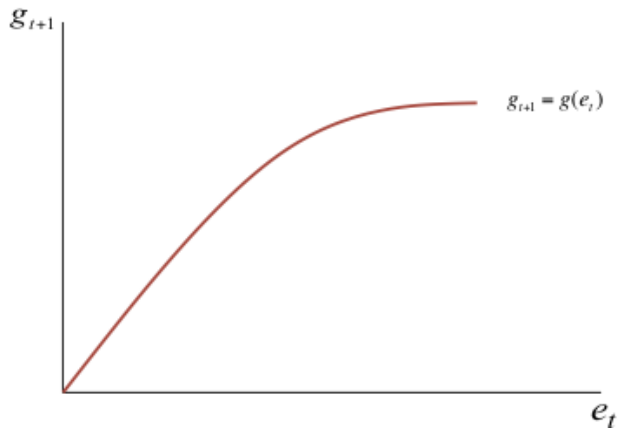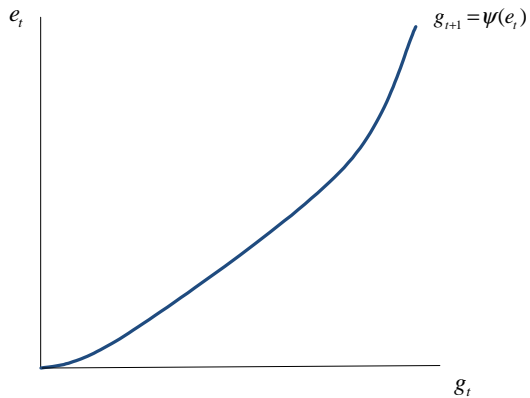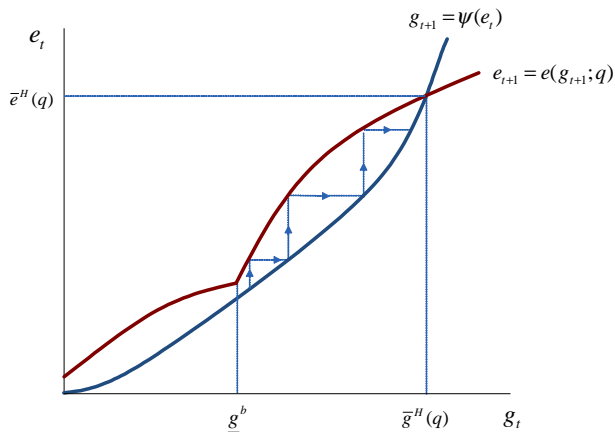
Technological Progress

The Evolution of Education and Technology: The Fraction of the Quality Type q=0

The Evolution of Education and Technology: The Fraction of the Quality Type q>0

The Evolution of Education and Technology: The Fraction of the Quality Type is Above the Threshold

The Evolution of the Quality Type and TFP Growth