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Economic Growth Under Weak and Strong Sustainability Scenarios

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TRIO

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Introduction

- ▶ Define economic growth and endogenous growth
- ▶ How do natural resources fit?
- ▶ Sustainability: motivation and modeling
- ▶ My model
- ▶ Results and implications

Economic Growth & Technological Change

- ▶ Exogenous: Solow (1956, 1957)
- ▶ Learning By Doing: Arrow (1962)
- ▶ Human Capital: Lucas (1988)
- ▶ Endogenous: Romer (1990)

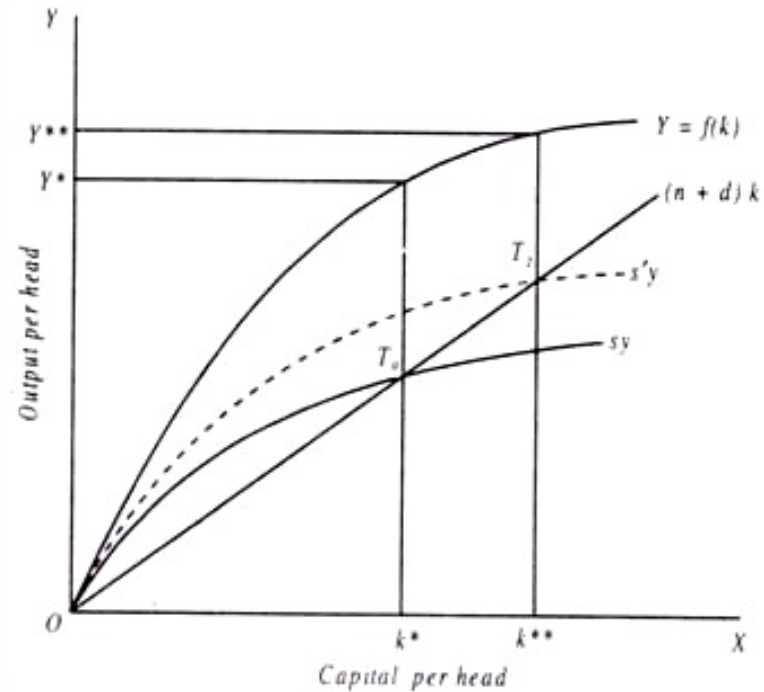
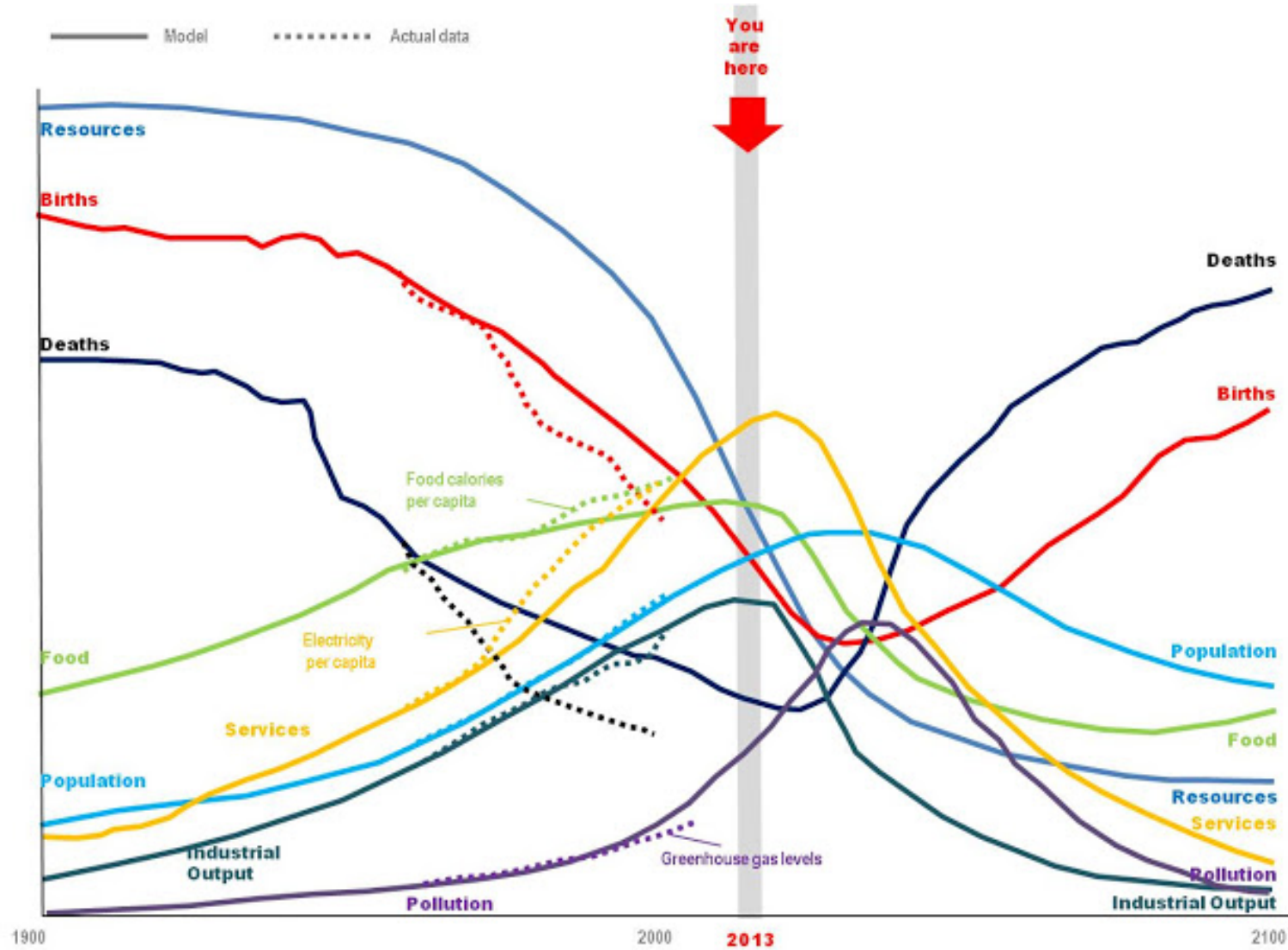


Fig. 45.3. Impact of Increase in Saving Rate

Limits to Growth...

Meadows, Meadows, & Randers (1974, 2004)



Natural Resources

- ▶ Depletable Resources:

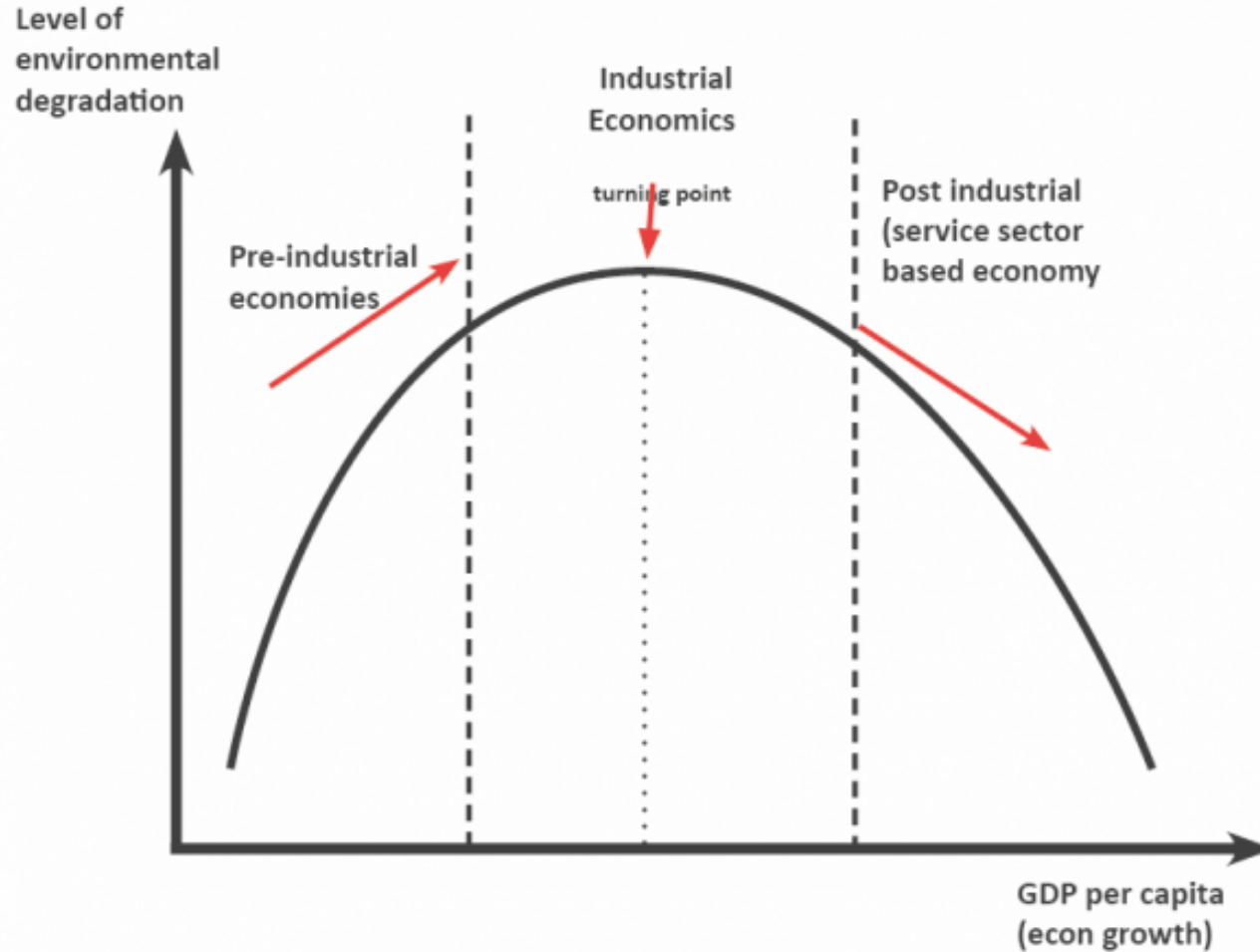
- ▶ Hotelling (1931);
- ▶ Stiglitz (1974);
- ▶ Dasgupta (1974)

- ▶ Pollution and Thermodynamics:

- ▶ Ayers (1999)

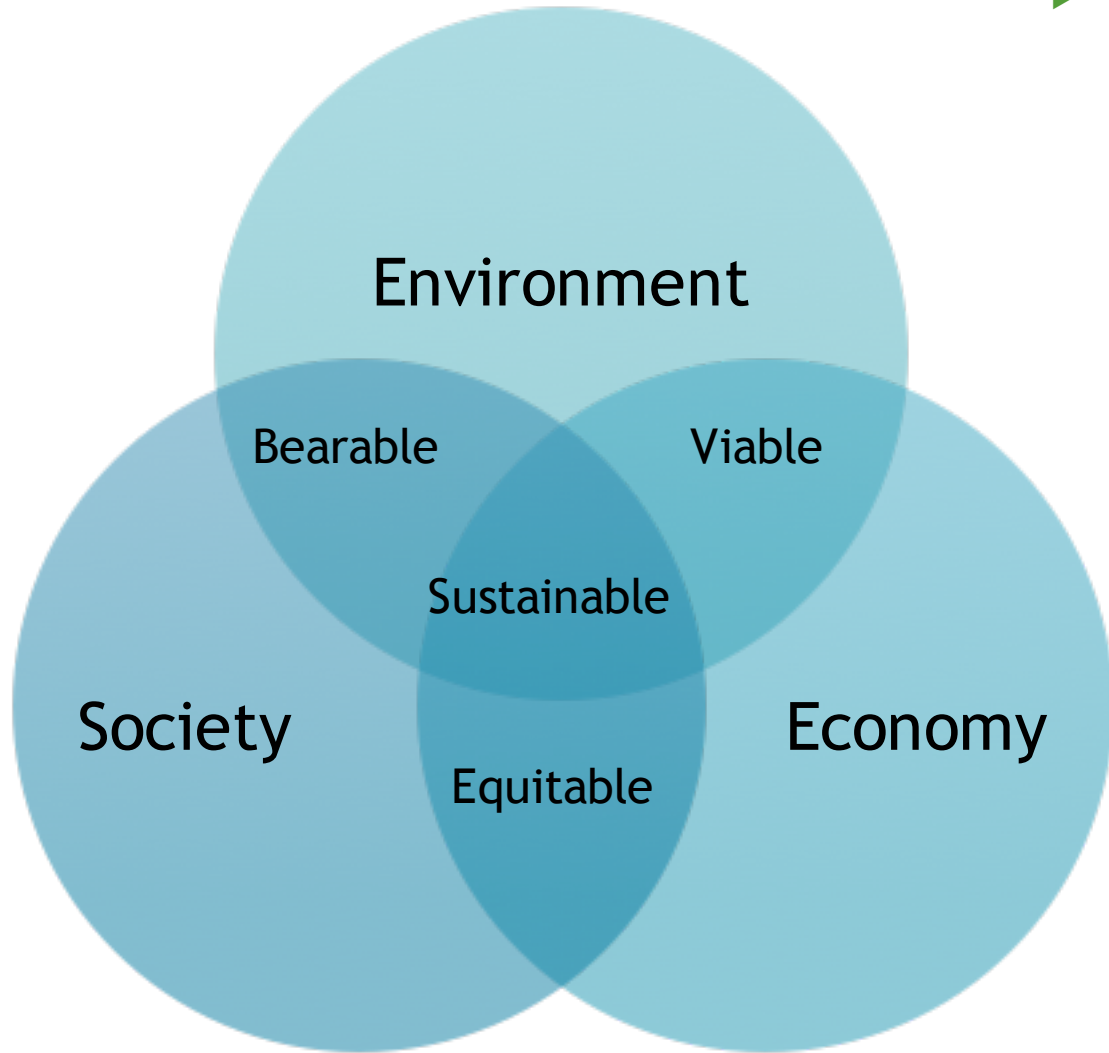
- ▶ Natural Resource Curse:

- ▶ Guilló & Perez-Sebastian (2015)



Environmental Kuznets Curve

Sustainability



- ▶ *“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*
Brundtland (1987)

- ▶ Balancing Present and future:
Chichilnisky (1996)

Degrees of sustainability

Reconciliation and trade-offs: Hediger (1999)

Weak Sustainability

- ▶ Maintain economic value
- ▶ Market and Technology *optimism*

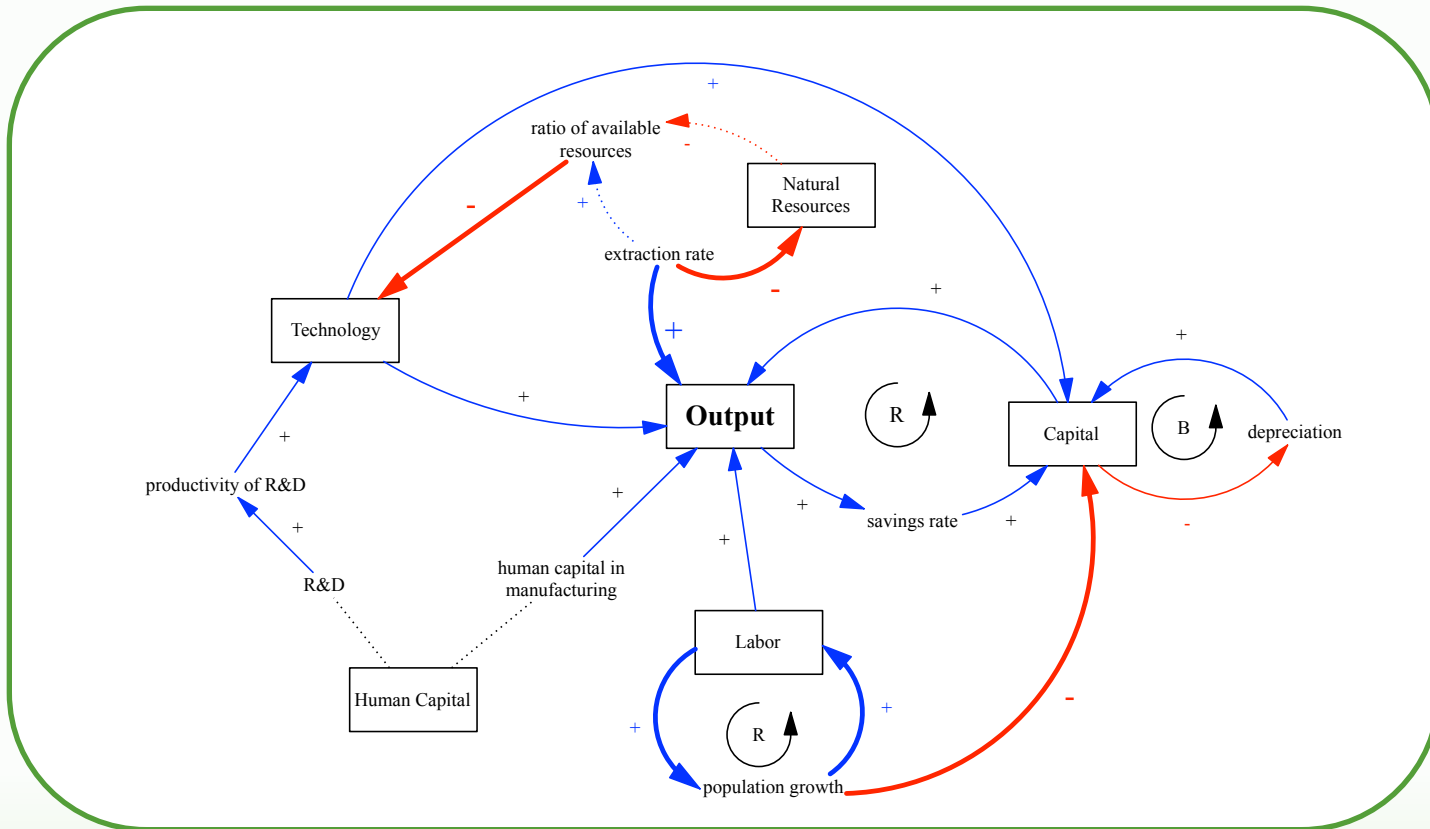
Strong Sustainability

- ▶ Preserve ecological value
- ▶ Economy and Environment are *compliments not substitutes*

Romer-Stiglitz Model: Barbier (1999)

maximize welfare of the least well-off generation

$$\max_{c, \delta, H} \{W(\rho s_0)\} = \max_{c, \sigma, H} \left\{ \int_0^{\infty} u(c, s) e^{-(\delta-n)t} dt \right\} \quad \text{subject to}$$



$$\text{Optimal Growth: } g^* = \frac{\sigma^*}{s} = \frac{Q^*}{K} = \delta - \frac{(1-\alpha_1) + \alpha_4 h^*}{\alpha_3} \sigma H_A^*$$

- ▶ $\mathcal{H} = u(c, s) + \lambda \dot{K} + \mu \dot{A} + \psi \dot{s}$
- ▶ Output: $Q = F(A, K, H_Q, L, \sigma)$
- ▶ Capital: $\dot{K} = Q - cL$
- ▶ Adjoint: $\dot{\lambda} - (\delta - n)\lambda = -\lambda F_K$
- ▶ Technology: $\dot{A} = \sigma H_A \cdot A - \omega \gamma$
- ▶ Adjoint: $\dot{\mu} - (\delta - n)\mu = -(\lambda F_A + \mu G_A)$
- ▶ Natural Resources: $\dot{s} = -\sigma$
- ▶ Adjoint: $\dot{\psi} - (\delta - n)\psi = \mu R_s$

My Model - *Weak* Sustainability

- ▶ Health of the Environment is essential for wellbeing
- ▶ $U(c, s) = \ln c + \ln s$
- ▶ Change in shadow price (cost) of resources:
- ▶ $\dot{\psi} - (\delta - n)\psi = -(u_s - \mu R_s) \implies \frac{1}{s} = \mu \frac{\omega \sigma}{s^2}$
- ▶ Towards a steady state develop technology to mitigate costs
- ▶ As $s \rightarrow 0$ and $\frac{\dot{A}}{A} = 0 \implies hAH_A = \frac{\omega \sigma}{s}$

My Model - *Strong* Sustainability

- ▶ Limit resource use: consume only a fraction of the total

- ▶ $s_0 \geq \rho s_0 > 0$ for $0 < \rho \leq 1$

- ▶ $\dot{s} \equiv \dot{s}_\rho = -\rho\sigma$

- ▶ Steady state: technology outpaces costs of environmental degradation

- ▶ as $\frac{\dot{A}}{A} \rightarrow 0 \Rightarrow hAH_A > \frac{\omega\sigma}{(1-\rho)s_0}$

What Next?

- ▶ Renewable and Nonrenewable resource systems
- ▶ Technology Switching
- ▶ Intergenerational and Intragenerational Equity
- ▶ An evolving environmental system

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Resources

- ▶ P3: <http://www.yourarticlelibrary.com/economics/neoclassical-theory-of-economic-growth-explained-with-diagrams/38321/>
- ▶ P4: <http://www.economicshelp.org/wp-content/uploads/2015/09/kuznets-environment-600x450.png>
- ▶ P5: <https://energiaemotori.files.wordpress.com/2014/04/limits-to-growth.jpg>

Thank you! - Questions?