Wealth breeds decline

Reversals of leadership and consumption habits

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Introduction

- Neoclassical growth models: per capita incomes in identical regions converge in the long run.

- Historical data: convergence, if any, is neither smooth nor monotonic (overtaking, decline, rebirth).

Literature

1. **New economic geography:**

   - Increasing returns to scale + low transportation costs $\Rightarrow$ economic agglomerations. More accrued with physical capital mobility (Desmet (2002)).

   - Urban costs generate dispersion/agglomeration/re-dispersion (Ottaviano, Tabuchi and Thisse (2002)).

   - New technology adopted by the poor region generates leapfrogging if the rich region does not because of the loss of accumulated experience$\Rightarrow$ leapfrogging, (Brezis, Krugman and Tsiddon (1993)).

2. Human capital literature:

- Divergence forces: social stratification across districts, regional funding of education.
- Convergence forces (which predominate):
  - Benabou (1996) Housing rent as social stratification cost$\Rightarrow$decrease income growth.
  - Tamura (2001): Teacher's quality main input of human capital production$\Rightarrow$human capital converges since teaching quality is higher in poor districts.
  - Galor, Moav and Vollrath (2002): a country can overtake a richer one if initial distribution of land is more egalitarian.

3. Institutional literature

- Acemoglu, Johnson and Robinson (2002): rich countries around 1500, colonized by European powers, are now poor and *vice versa*. Extractive institutions were imposed in rich countries $\Rightarrow$ reversal of fortune.

In this model:

- Leapfrogging does not rely on exogenous shocks.
- Convergence not guaranteed despite of capital mobility.
- Leadership is more than stocks of physical and human capital, consumption habits are introduced.

What we do:

1. Examples of alternating primacy

2. A model of reversal

3. Regional dynamics

4. The role of capital mobility

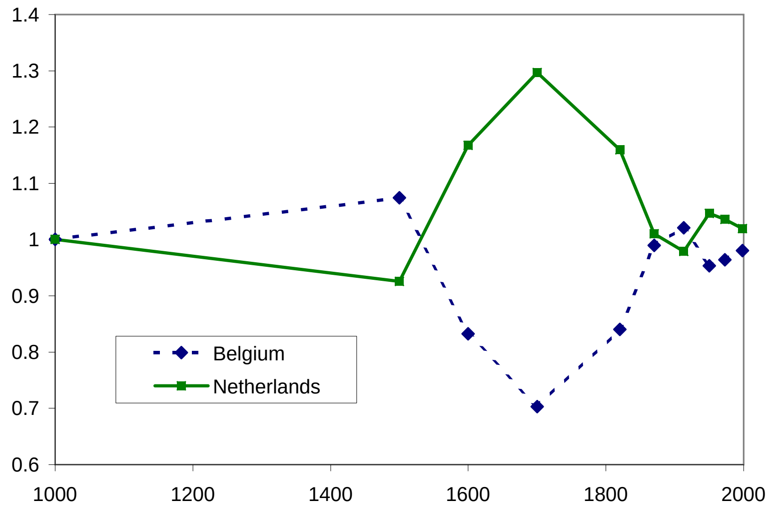
5. Case study: Belgium-the Netherlands (1500-2000)

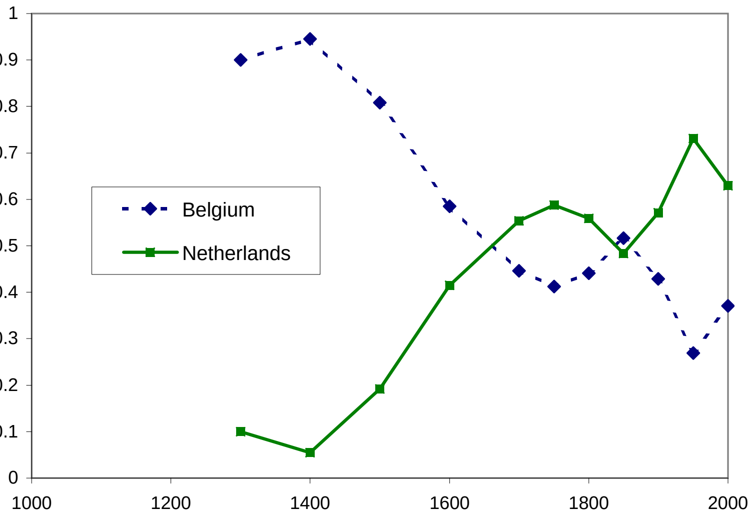
Examples of alternating primacy

- Roman Empire's decline: physical and human resources where allocated to entertainment instead of investment in knowledge and infrastructure.

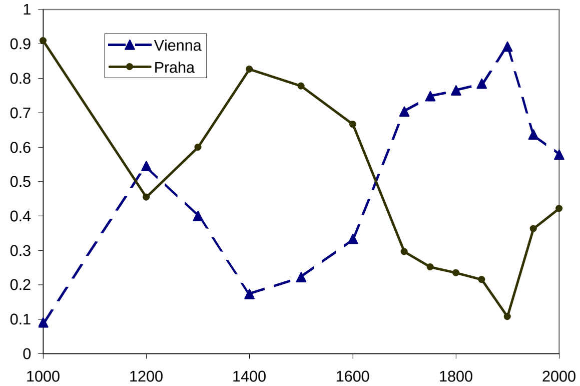
- Amalfi, largest city-state in Italy in the X century (60-80,000 people). Now, 7,000 inhabitants. Neighboring Naples now has 1 mil. people.

- Belgium - the Netherlands

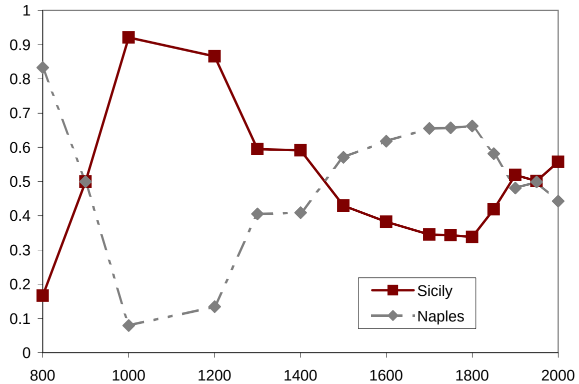




- Vienna-Prague



- Sicily-Naples



Model

- OLG model with physical capital and knowledge.
- 2 regions A,B.
- Population does not grow, normalized to one.
- Generations live two periods:
  - Period 1: Households work, consume and invest in physical capital and to accumulate knowledge.
  - Period 2: they consume their savings.
- Firms: produce a single good with a c.r.s. technology.
- Physical capital is perfectly mobile across regions. Labor is immobile.

- The model economy in a nutshell:
  - 2 regions, physical capital is perfectly mobile across them,
  - both produce the same good, with identical technology,
  - individuals have the same preferences,
  - regions have different levels of knowledge and consumption habits.
- Dynamics:
  1. Consumption habits are built from previous generation.
  2. If young generation has high living standards $\Rightarrow \downarrow$ investment in knowledge.
  3. That region loses leadership.

Preferences

$$\ln(c_{i,t} - \gamma a_{i,t}) + \beta \ln(d_{i,t+1}) + \lambda \ln(e_{i,t}) \qquad i = A, B,$$

where

- $c_{i,t}$: youth-age consumption,
- $a_{i,t}$: consumption habits,
- $d_{i,t}$: old-age consumption,
- $e_{i,t}$: spending on knowledge,
- $\gamma \in (0,1)$: influence of habits on preferences,
- $\lambda > 0$: taste for spending on education,
- $\beta > 0$: discount factor.

We assume that:

- Depreciation rate (*forgetting rate*) of consumption habits is so high that old persons are not affected by them.

  Empirically: old households put less weight on comparisons to compare their welfare (Clark, Oswald and Warr (1996)).

- $\lambda \ ln(e_{i,t})$: "*joy of giving*". Providing education to their children make parents happy.

Stock of habits $a_{i,t} = c_{i,t-1}$

Technology

$$Y_{i,t} = A_{i,t} K_{i,t}^{\alpha} N_{i,t}^{1-\alpha},$$

where

$$A_{i,t} = A\ h_{i,t}^{\mu},$$

and

- $h_{i,t}$: knowledge,

$$h_{i,t+1} = \psi e_{i,t},$$

  ψ is a technological parameter (w.l.g. $\psi = 1$).

- μ: elasticity of total factor productivity to knowledge.

We assume that $\alpha + \mu < 1$.

Optimal behaviors

$$Max_{c,d,e} \ln(c_{i,t} - \gamma a_{i,t}) + \beta \ln(d_{i,t+1}) + \lambda \ln(e_{i,t})$$

subject to

$$\begin{aligned} c_{i,t} + s_{i,t} + e_{i,t} &= \omega_{i,t}, \\ d_{i,t+1} &= R_{i,t+1} s_{i,t}. \end{aligned}$$

First order conditions yield:

$$\begin{aligned} c_{i,t} &= \frac{1}{1+\delta} \left(\omega_{i,t} + \gamma \delta a_{i,t} \right), \\ e_{i,t} &= \frac{\lambda}{1+\delta} \left(\omega_{i,t} - \gamma a_{i,t} \right), \\ s_{i,t} &= \frac{\beta}{\lambda} e_{i,t}, \end{aligned}$$

where $\delta = \lambda + \beta$.

- Firm level: max profits. MP equal factor prices.

Equilibrium

Perfect mobility of physical capital:

$$R_{A,t} = R_{B,t} = R_t$$

Total stock of capital

$$K_{t+1} = K_{A,t+1} + K_{B,t+1} = N_{A,t} s_{A,t} + N_{B,t} s_{B,t}.$$

Given initial conditions $\{h_{i,0}, a_{i,0}, k_{i,0}\}_{i=A,B}$ satisfying

$$h_{A,0}^{\frac{\mu}{1-\alpha}} k_{B,0} = h_{B,0}^{\frac{\mu}{1-\alpha}} k_{A,0}, \quad \text{and} \quad k_{A,0} + k_{B,0} = \frac{\beta}{\lambda}(h_{A,0} + h_{B,0})$$

a competitive equilibrium is characterized by a path $\{h_{i,t}, a_{i,t}, k_{i,t}\}_{i=A,B,t>0}$, such that

$$\begin{aligned}
h_{i,t} &= \frac{\lambda}{1+\delta}\left[(1-\alpha)Ah_{i,t-1}^{\mu}k_{i,t-1}^{\alpha} - \gamma a_{i,t-1}\right], \\
a_{i,t} &= \frac{1}{1+\delta}\left[(1-\alpha)Ah_{i,t-1}^{\mu}k_{i,t-1}^{\alpha} + \gamma\delta a_{i,t-1}\right], \\
k_{A,t} + k_{B,t} &= \frac{\beta}{\lambda}(h_{A,t} + h_{B,t}), \\
h_{A,t}^{\frac{\mu}{1-\alpha}} k_{B,t} &= h_{B,t}^{\frac{\mu}{1-\alpha}} k_{A,t}.
\end{aligned}$$

Regional dynamics and consumption habits

- Steady State:

$$\bar{h}_A = \bar{h}_B = \bar{h} = \left(\frac{A(1-\alpha)(1-\gamma)\lambda^{1-\alpha}\beta^{\alpha}}{1+(\beta+\lambda)(1-\gamma)} \right)^{\frac{1}{1-\mu-\alpha}},$$

$$\bar{k}_A = \bar{k}_B = \bar{k} = \frac{\beta}{\lambda}\,\bar{h},$$

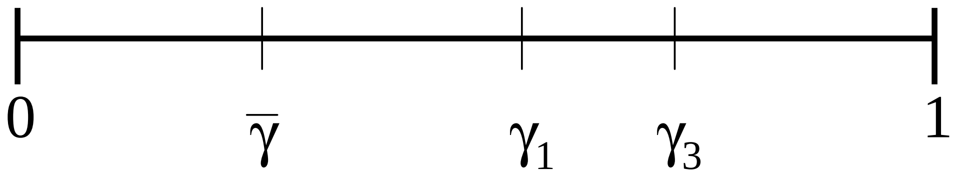
$$\bar{a}_A = \bar{a}_B = \bar{a} = \frac{\bar{h}}{\lambda(1-\gamma)}.$$

- Dynamics: described by a system of four difference equations.

Proposition 1 [Hopf bifurcation]

There exists a value $\gamma_1 \in (0,1)$ *such that at* $\gamma = \gamma_1$ *the steady state (1) is non-hyperbolic, the eigenvalues of the Jacobian of the linearized system have moduli less than unity with the exception of a conjugate pair of complex eigenvalues of modulus 1,* $\{\ell_\gamma, \bar{\ell}_\gamma\}$*. This pair of eigenvalues also satisfies* $\ell_\gamma^3 \neq 0$*,* $\ell_\gamma^4 \neq 0$ *and* $\partial \ell_\gamma / \partial \gamma > 0$ *at* $\gamma = \gamma_1$*.* γ_1 *is given by the following expression:*

$$\gamma_1 = \frac{(1+\delta)(1+\alpha+\mu) - \sqrt{(1+\delta)^2(1+\alpha+\mu)^2 - 4\delta(1+\delta)(\alpha+\mu)}}{2\delta(\alpha+\mu)}.$$



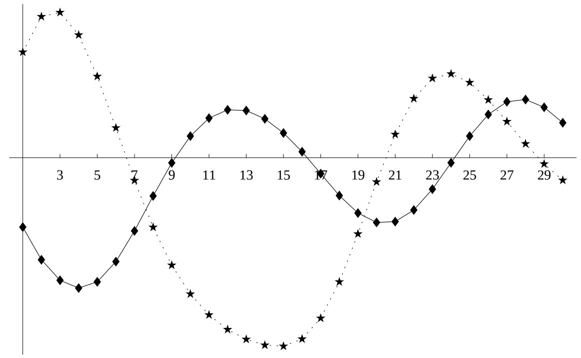
Depending on the value of γ, the dynamic system can show three different behaviors:

- $\exists\bar{\gamma}$ s.t. for $\gamma < \bar{\gamma} \Rightarrow$ Monotonic convergence.
- For $\gamma \in (\bar{\gamma}, \gamma_1) \Rightarrow$ Oscillatory convergence.
- For $\gamma > \gamma_1 \Rightarrow$ the system does not converge to the steady state.

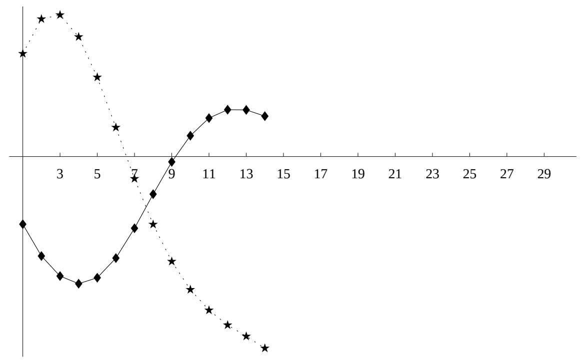
Numerical example

- Parameter values: $\alpha = 1/3$, $\beta = 1/2$, $\lambda = 1/2$, $\mu = 1/2$ and $A = 10$. Then $\gamma_1 = 0.6379$. We choose $\gamma = 0.62$.
- Initial conditions:
  - $a_{A,0} = a_{B,0} = \bar{a}$;
  - $k_{A,0}$, $k_{B,0}$ set to match their long run values.
- Four different cases:
  1. Alternating primacy;
  2. Irreversible decline;
  3. Synchronized waves;
  4. Monotonic convergence;

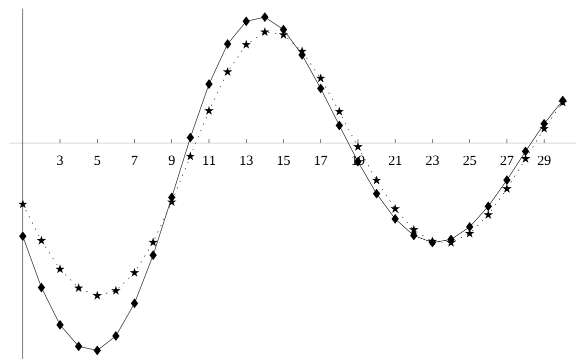
1. $h_{A,0} = \bar{h} * 1.751$ and $h_{B,0} = \bar{h}/1.751$;



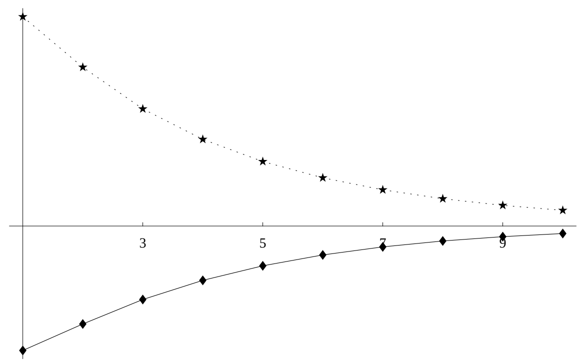
2. $h_{A,0} = \bar{h} * 1.752$ and $h_{B,0} = \bar{h}/1.752$;



3. $h_{A,0} = \bar{h} * 0.8$ and $h_{B,0} = \bar{h} * 1.7$;



4. $h_{A,0}$, $h_{B,0}$ as in 1, but $\gamma = 0.05$;



The role of capital mobility

- A competitive equilibrium $\{h_{i,t}, a_{i,t}, k_{i,t}\}_{i=A,B,t>0}$ verifying $k_{i,0} = \beta/\lambda h_{i,0}$ is characterized by:

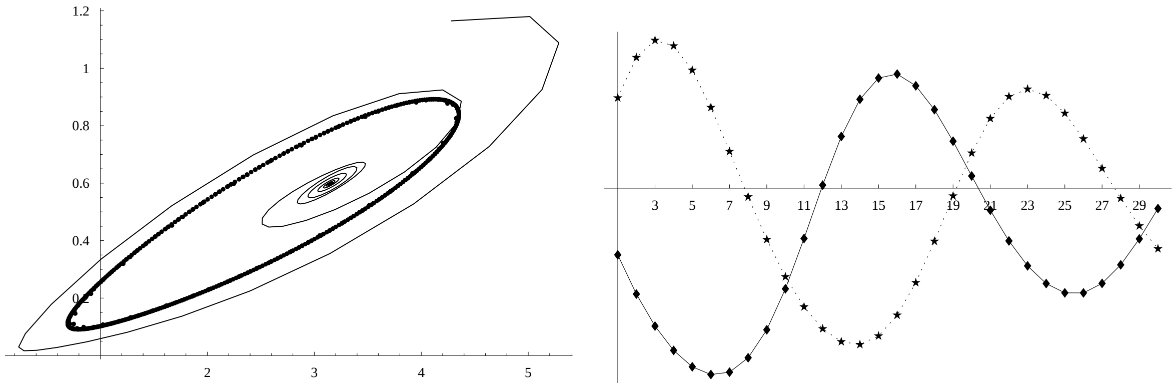
$$
\begin{aligned}
h_{i,t} &= \frac{\lambda}{1+\delta}\left((1-\alpha)Ah^{\mu}_{i,t-1}k^{\alpha}_{i,t-1} - \gamma a_{i,t-1}\right), \\
a_{i,t} &= \frac{1}{1+\delta}\left((1-\alpha)Ah^{\mu}_{i,t-1}k^{\alpha}_{i,t-1} + \gamma\delta a_{i,t-1}\right), \\
k_{i,t} &= s_{i,t-1} = \frac{\beta}{\lambda}h_{i,t}, \qquad i = A, B.
\end{aligned}
$$

- The SS is identical to the case with capital mobility.
- Hopf bifurcation at γ_1.

- **But** convergence speed is slower.

- **Moreover**, capital mobility enlarges the basin of attraction of the SS and promotes synchronization.

Proposition 2 [No capital mobility]
With no capital mobility, the steady state is locally stable for $\gamma \in [0, \gamma_1)$. *For* γ *in a neighborhood on the left of* γ_1, *the speed of convergence is slower than with perfect mobility of capital.*



Case study: Belgium - the Netherlands

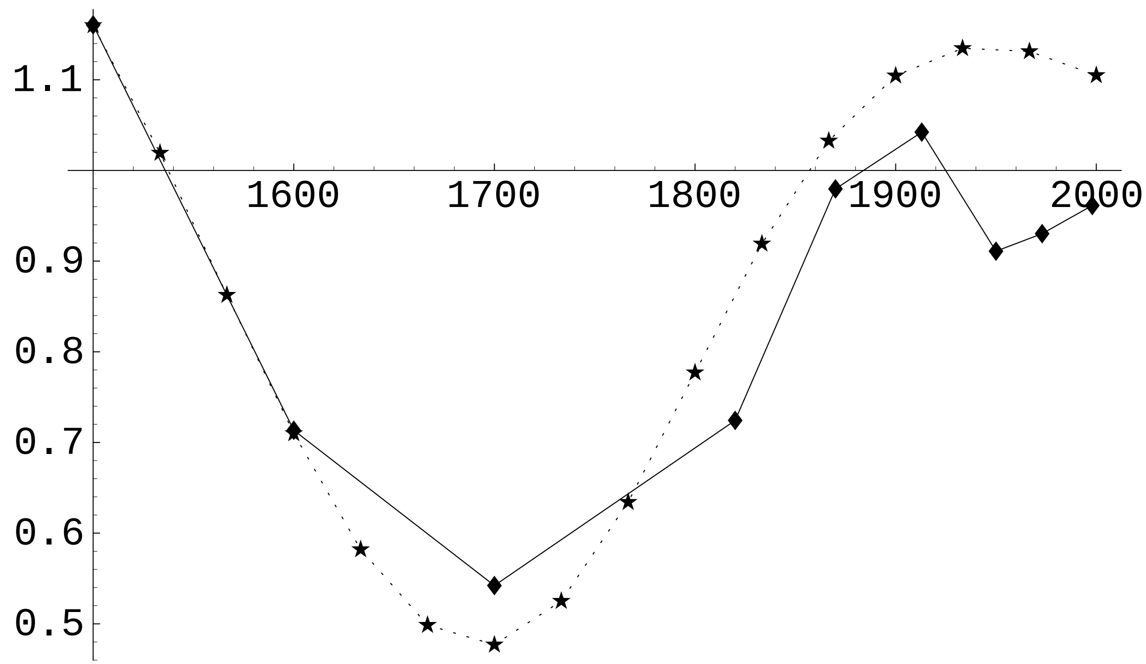
Simulate Belgium (B)- the Netherlands (NL) relative GDP from 1500-2000.

Initial conditions for Belgium and the Netherlands in 1500:

year 1500	Belgium (B)	the Netherlands (NL)	B/NL
Knowledge ($h_{i,0}$)	0.598	0.491	1.219
Habit stock ($a_{i,0}$)	4.033	3.147	1.281
GDP per capita*	875	754	1.16

*Source: Maddison (1995)

Simulated (dots) vs Actual (solid) Relative GDP per capita – B/NL



Conclusion

- We have formalized Kindleberger (1996) idea: *wealth breeds first more wealth, then decline.*

- Differences across regions structurally identical may persist, even if physical capital flows from rich to poor regions.

  If dispersion of knowledge is high and habit formation is strong $\rightarrow$ alternating primacy.

- Unsustainable habits $\rightarrow$ irreversible decline.

- Weight of habits is low $\rightarrow$ monotonic convergence.