ECONOMICS II
MACROECONOMICS

BMEGT30A101
BMEGT30A103
Monday: 8.15–9.45 (QA240)

ECONOMIC GROWTH
CH 8–9

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Consulting hours: Monday 10–11, QA215

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   – Level or growth?
   – Comparative dynamics, panel analysis and graphs

2. **Sources of economic growth, growth accounting**

3. **How to *make* a *closed* economy *rich*? – Neoclassical Solow model**
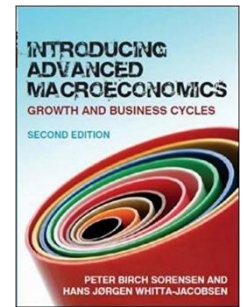   – Steady state, stability, balanced growth
   – The Golden Rule level of Capital
   – Policy implications
   – Convergence

4. **Alternative approaches, conclusion**

Gazdaság- és Társadalomtudományi Kar • Közgazdaságtan Tanszék

1. PROBMLEMS

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Gazdaság- és Társadalomtudományi Kar • Közgazdaságtan Tanszék

Macroeconomics
–as a subject matter–

➤ „At the risk of oversimplifying, we may … say that **macroeconomics is a study of economic growth and business cycles**" (Sorensen–Whitta-Jacobsen, 2010 p2)

+ C, I, U, interactions with nominal variables (W,P, E,M,R)

➤ „Empiricist view": Explaining observed time series for economic variables

Sorensen, P. B. – Whitta-Jacobsen, H. J. (2010): INTRODUCING ADVANCED MACROECONOMICS. (2nd ed.) McGraw-Hill. London.

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Long-run economic growth

- Long-run economic growth is the single most important determinant of the economic well-being of a nation's citizens.

- Why does standard of living differ so much among countries of the world?

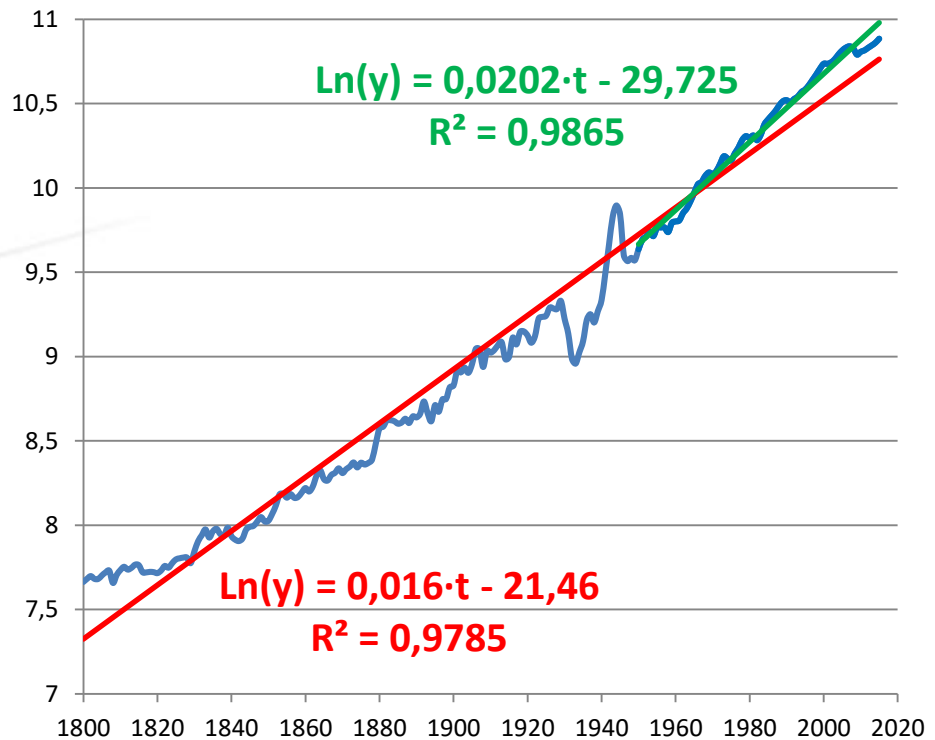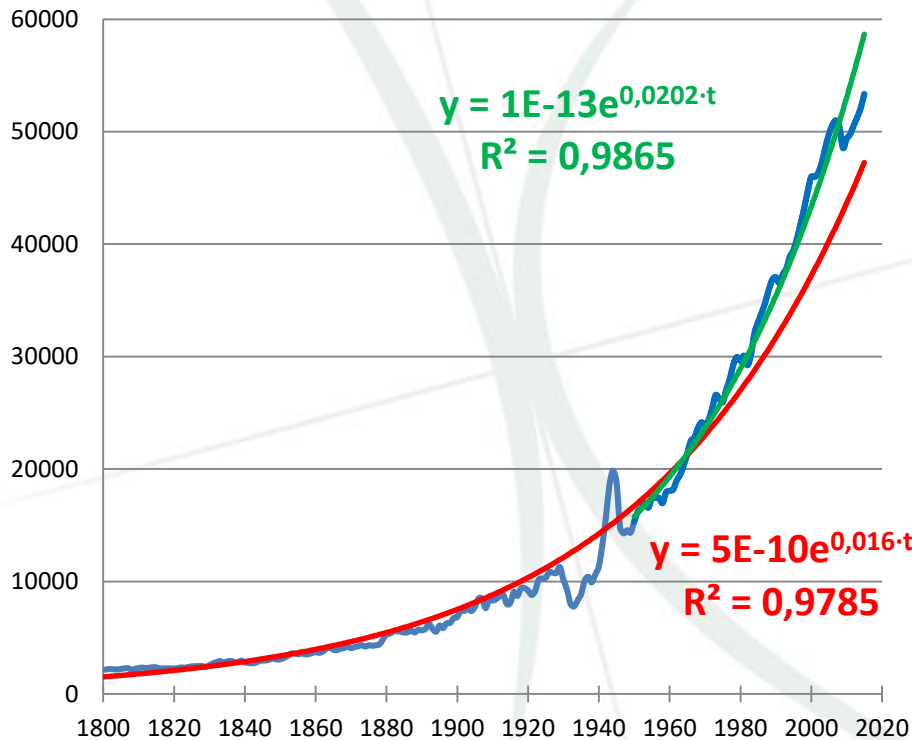Gazdaság- és Társadalomtudományi Kar • Közgazdaságtan Tanszék

What is economic growth about?

- **Economic growth**:
  - change in GDP or GNI (Y(t)) – economic pie
  - change in GDP/capita (y(t) =Y(t)/L(t)) – slice of the pie $\rightarrow$ PPP (Purchasing Power Parity)

- **Purpose of growth figures**:
  - comparative dynamics – time series
  - international comparison – panel data

- **Terms and definitions**
  - Level of standard of living: y(t)
  - Growth rate: $G_y \doteq \frac{\Delta y}{y} \approx \frac{dy/dt}{y} = \frac{\dot{y}}{y} = \frac{dln[y(t)]}{dt}$ $\rightarrow$ slope of the trend line
  - $G_{Y/L} = G_Y - G_L$ and $G_{EL} = G_E + G_L$ and $G_{K^\alpha} = \alpha G_K$

Comparative dynamics
USA GDP/CAP trend

1800–2015

1950–2015

Left chart:

$y = 1E\text{-}13\,e^{0,0202 \cdot t}$
$R^2 = 0{,}9865$

$y = 5E\text{-}10\,e^{0,016 \cdot t}$
$R^2 = 0{,}9785$

Right chart:

$Ln(y) = 0{,}0202 \cdot t - 29{,}725$
$R^2 = 0{,}9865$

$Ln(y) = 0{,}016 \cdot t - 21{,}46$
$R^2 = 0{,}9785$

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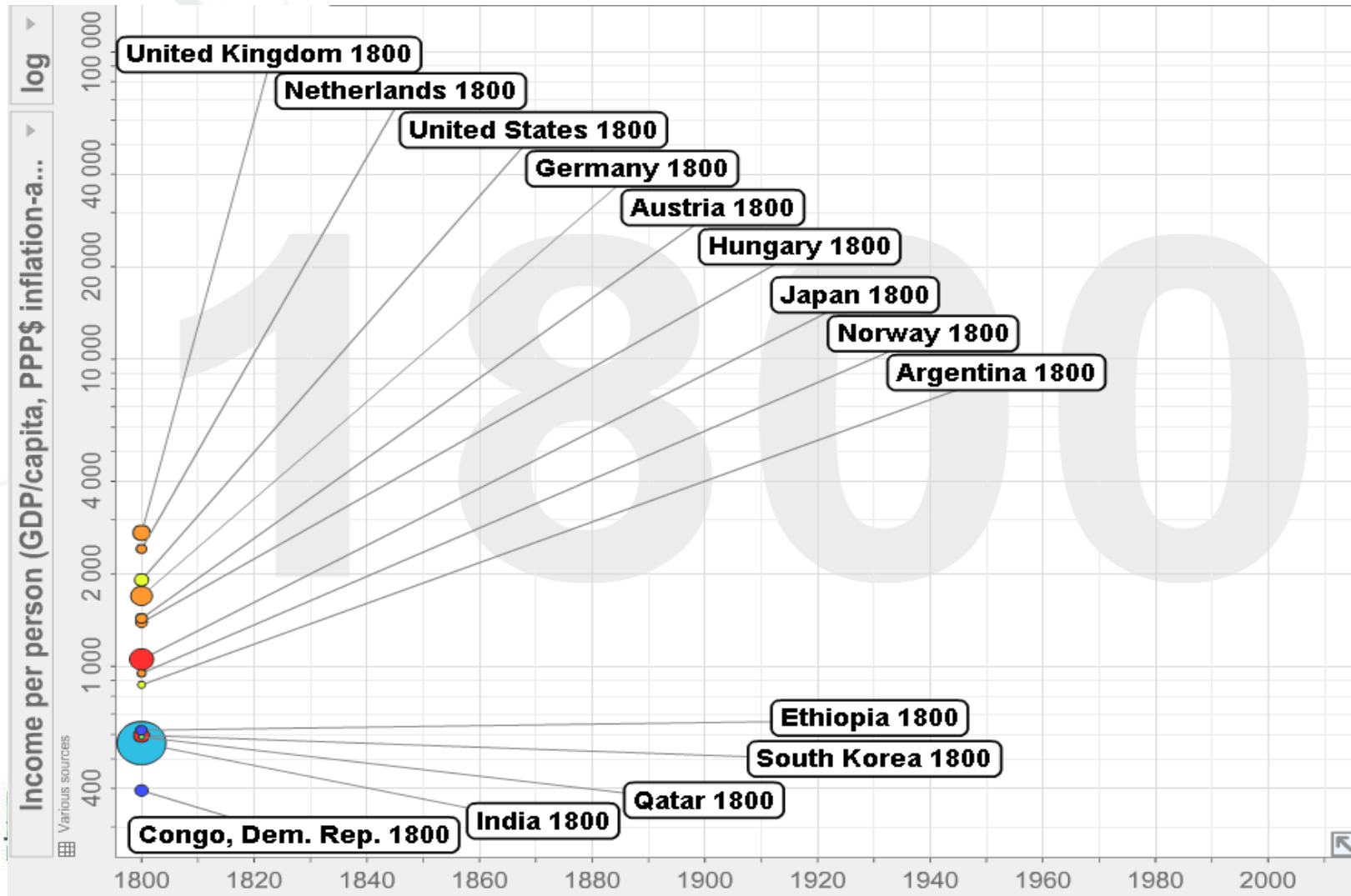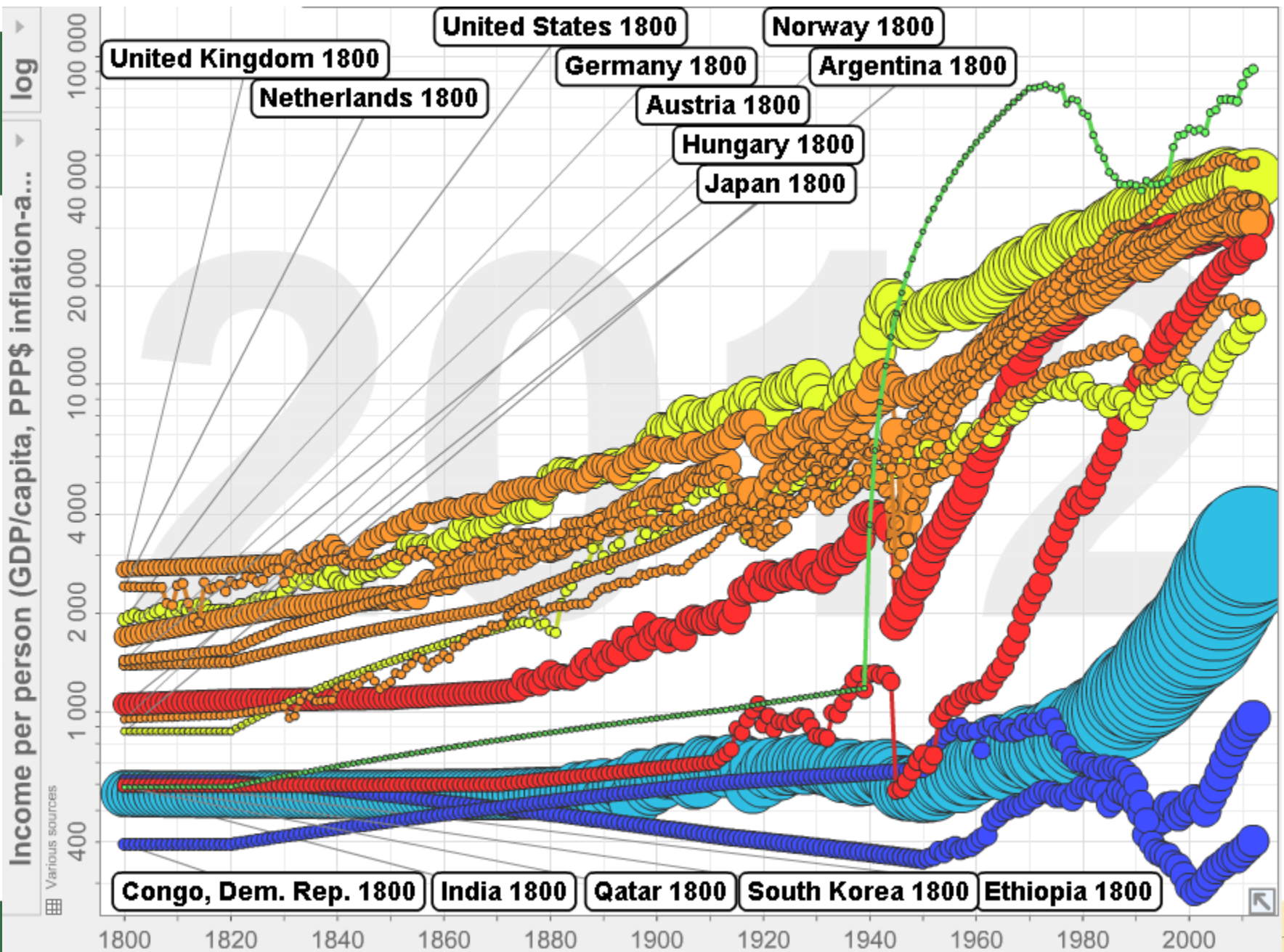MŰEGYETEM 1782

International comparison

2. Sources of economic growth

Growth accounting

- $Y=F(K,L)$ constant return to scale: $zY = F(zK,zL);\ \forall z>0$

- „Cobb–Douglas economy": $Y=A(t)\cdot[K(t)]^{\alpha}\cdot[L(t)]^{1-\alpha}$
  - CH3 Euler's theorem

- $G_{GDP} \quad = G_Y = G_A+\alpha G_K+(1-\alpha)G_L$

- $G_{GDP/CAP} = G_y = G_A+\alpha(G_K-G_L) = G_A+\alpha G_k$

- **TFP** = Solow residual = factor of our ignorance = „technological change"

- $\mathbf{G_A} = G_Y -\alpha G_K -(1-\alpha)G_L$

TABLE 9-2

Accounting for Economic Growth in the United States

Years	Output Growth $\Delta Y/Y$	=	Capital $\alpha\Delta K/K$	+	Labor $(1-\alpha)\Delta L/L$	+	Total Factor Productivity $\Delta A/A$	
				(average percentage increase per year)				
1948–2013	3.5		1.3		1.0		1.2	**34%**
1948–1972	4.1		1.3		0.9		1.8	**44%**
1972–1995	3.3		1.4		1.4		0.5	**15%**
1995–2013	2.9		1.1		0.6		1.1	**38%**

2019. 04. 01.

Gazdaság- és
Li

3. How to *make* a *closed* economy *rich*?
– NEOCLASSICAL SOLOW MODEL –

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Solow model

- Labor-augmenting technological progress:

  E·L = effective number of workers

$$\dot{L}/L = G_L = n \geq 0 \quad \text{natural rate of growth}$$

$$\delta \quad \text{depriciation rate of capital } (0 \leq \delta << 1)$$

$$\dot{E}/E = G_E = g \quad \text{technological progress}$$

$$s \quad \text{constant savig rate } (0 \leq s \leq 1)$$

$$zY = F\left[zK, z(EL)\right] \quad z = \frac{1}{EL}$$

$$\frac{Y}{EL} = \boxed{y} = F\left(\frac{K}{EL}, 1\right) = \boxed{f(k)}$$

$$\boxed{\dot{K}} = I - \delta K = S - \delta K = sY - \delta K$$

$$\dot{k} = \frac{d\left(\frac{K}{EL}\right)}{dt} = \frac{\dot{K}EL - K\dot{E}L - KE\dot{L}}{(EL)^2} = \boxed{\frac{\dot{K}}{EL}} - \frac{\dot{E}}{E}k - \frac{\dot{L}}{L}k$$

$$\left.\vphantom{\frac{d\left(\frac{K}{EL}\right)}{dt}}\right\} \quad \dot{k} = sy - (n + g + \delta)k$$

- $Y = (EL)f\left(\dfrac{K}{EL}\right) \Rightarrow MPK = \dfrac{dY}{dK} = (EL)f'\dfrac{1}{EL} = f'$

Steady state

$$\dot{k} = sf(k) - (n + g + \delta)k = 0$$

$$\frac{dG_k}{dk} < 0 \Rightarrow k^* \text{ stabile equilibrium}$$

FIGURE **9-1**

Investment, break-even investment

Break-even investment, $(\delta + n + g)k$

Investment, $sf(k)$

k^* Capital per effective worker, k

The steady state

Policies (comparative dynamics):

– $n_1 > n_2$ → level effect

– $s_1 < s_2$ → level effect $\dfrac{dk^*(s)}{ds} > 0$

– $g_1 < g_2$ → growth effect

$G_k = 0 = G_{K/L} - g$ ➜ $G_{Y/L} =$ **G$_{GDP/CAP}$ = g > 0** → **Balanced growth**

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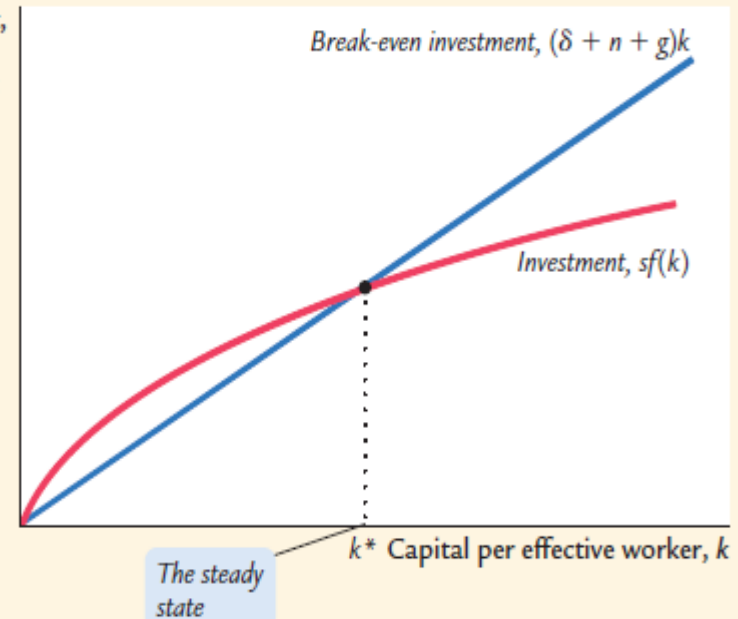
Golden Rule Level of Capital

$$\max_s c = \max_s \left\{ (1-s) \cdot \boxed{f\left(k^*(s)\right)} \right\}$$

$$\boxed{\dot{k} = 0} \Leftrightarrow \boxed{sf\left(k^*(s)\right)} = \left(n+g+\delta\right)k^*(s) \Rightarrow \boxed{k\,/\,y = \frac{s}{\left(n+g+\delta\right)}}$$

$$f'\frac{dk^*(s)}{ds} - \left(n+g+\delta\right)\frac{dk^*(s)}{ds} = 0$$

$$\frac{dk^*(s)}{ds}\left[f' - \left(n+g+\delta\right)\right] = 0 \Leftrightarrow \boxed{f' = \left(n+g+\delta\right)}$$

- The optimal saving rate

$$\varepsilon_K^Y = \frac{dY}{dK}\frac{K}{Y} = \boxed{f'}\,\boxed{\frac{K\,/\,EL}{Y\,/\,EL}} = \boxed{\left(n+g+\delta\right)}\boxed{\frac{s}{\left(n+g+\delta\right)}} = s$$

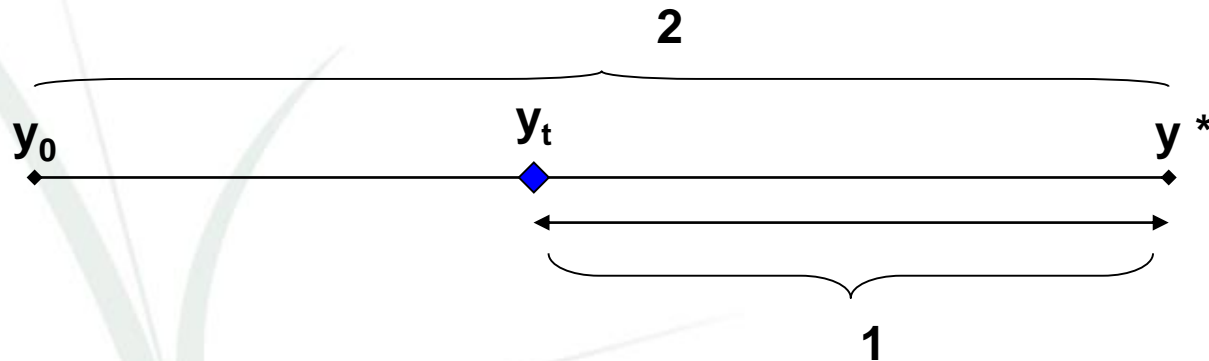Gazdaság- és Társadalomtudományi Kar   •   Közgazdaságtan Tanszék

Absolute convergence
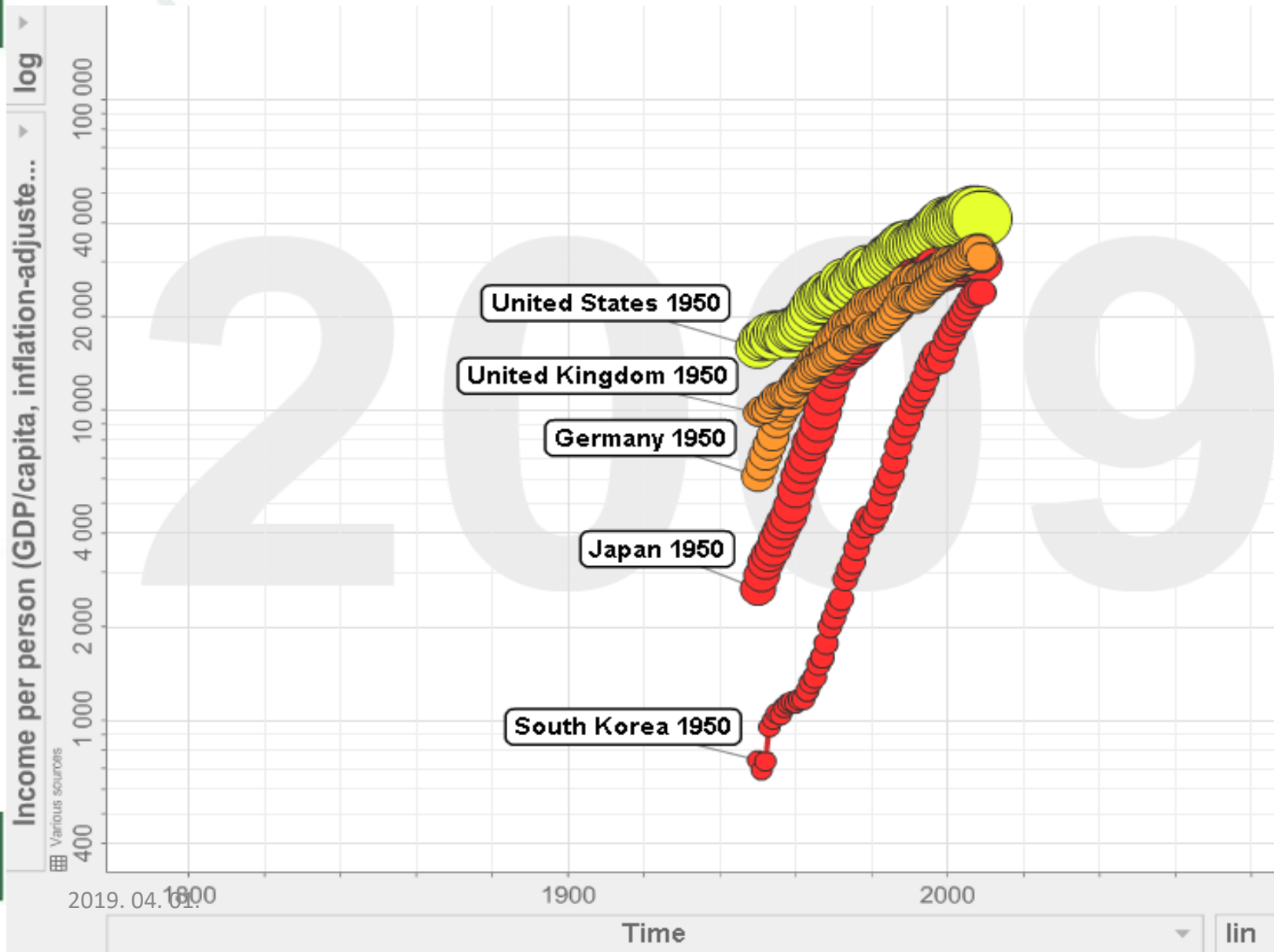
Absolute vs Conditional convergence

$$G_k = \frac{d \ln(k)}{dt} = \frac{s \cdot f(k)}{k} - (n + g + \delta)$$

sf(k)/k

G_k^{sz}

G_k^{g}

n+g+δ

k_{0sz} k_{0g} k^*

k

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M Ű E G Y E T E M   1 7 8 2

Gazda... ...mtudományi Kar   •   Közgazdasá... ...szék
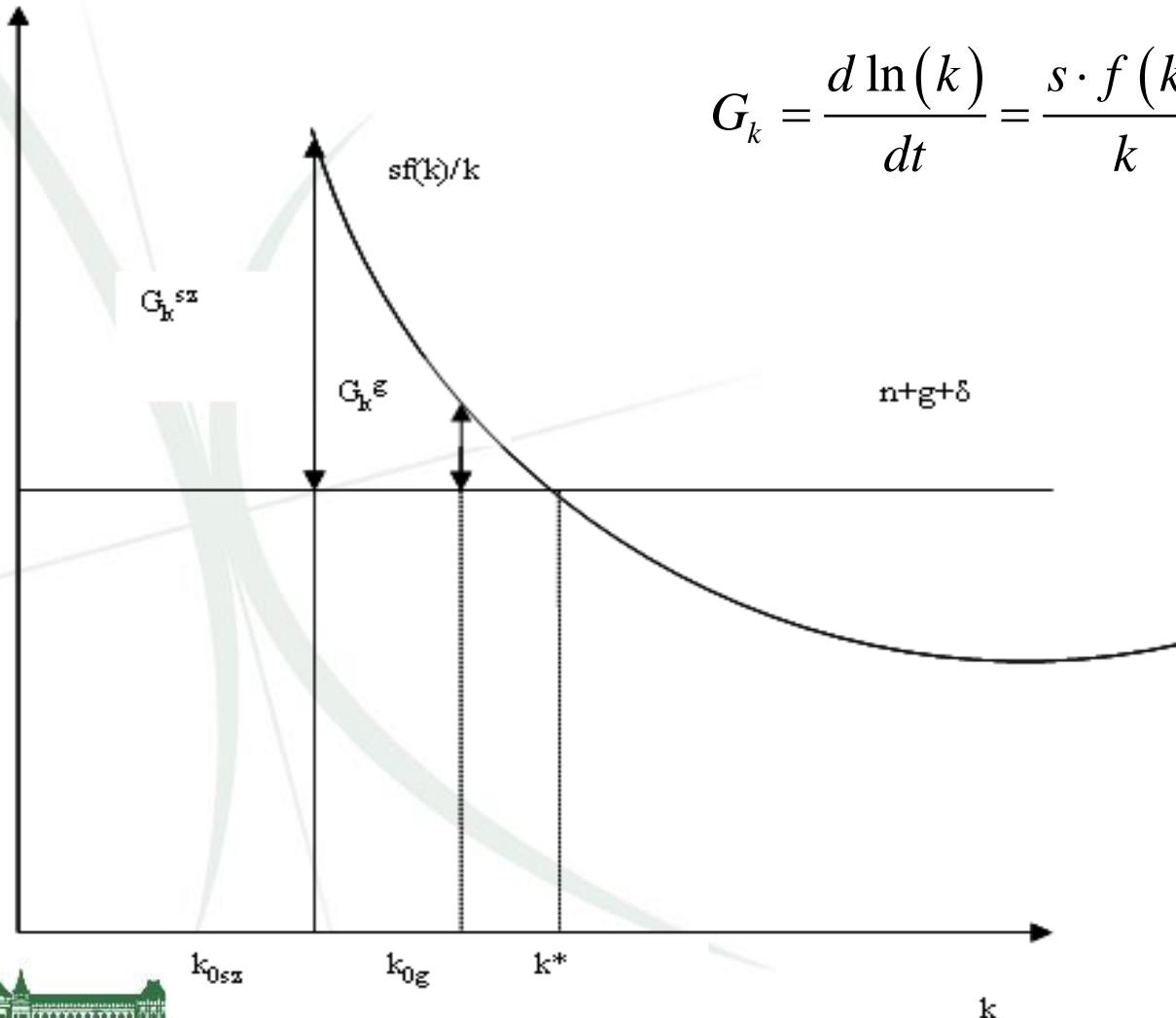
Speed of convergence
<u>close</u> to the equilibrium

2

y_0 y_t y^*

1

$$e^{\beta t} = \frac{\ln y_0 - \ln y^*}{\ln y_t - \ln y^*} = \frac{y_0 - y^*}{y_t - y^*}$$

$$T = \frac{\ln\left(\dfrac{y_0 - y^*}{y_T - y^*}\right)}{\beta} = \frac{\ln\left(\dfrac{2}{1}\right)}{\beta} \approx \frac{70}{\beta(\%)}$$

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4. ALTERNATIVE APPROACHES

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Hypotheses

- Extensive growth – factor accumulation, re-distribution of factors
- Intensive growth
    - Differences in the production function (technological change, positive externalities, spillover)
    - Quality of the nation's institutions, including the government policymaking

- Allocating Economy's Investment
    - Public capital, called infrastructure
    - Human capital is at least as important as physical capital in explaining international differences in standard of living.
- Industrial policy (mistakes) – Japan
- Free trade is good for economic growth (←specialization, economy of scale)

- ENDOGENOUS GROWTH MODELS
    - **Joseph Schumpeter**: **creative destruction** (new product, new way to produce, other innovations)
    - Paul M. Romer: „learning by doing"
        The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018

    - Ageing and Growth (*The Economist* 2019-03-30)

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közgazdaságtan tanszék

Acemoglu, D. – Robinson, J. A.

Why Nations Fail? - The Origins of Power, Prosperity and Poverty

- <u>Inclusive economic and political institutions</u>

- The quality of institutions is a key determinant of economic performance

- Government as a „helping hand"
  – Protecting property rights
  – Enforcing contracts
  – Promoting competition
  – Prosecuting fraud …

- <u>Extractive institutions</u>

DARON ACEMOGLU & JAMES A. ROBINSON

A HATALOM, A JÓLÉT ÉS A SZEGÉNYSÉG EREDETE

MIÉRT BUKNAK EL NEMZETEK?

hvg könyvek

- **Institutions**: Norms, rules of conduct, and generally accepted ways of doing things.

- **Economic institutions** are humanly devised constraints that shape human interactions including both formal and informal „rules of the game" of economic life

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CONCLUSION

- **FACTORS (SOURCES) OF ECONOMIC GROWTH**
  - LUCK
  - TIME
  - HUMAN DECISIONS (THE RULING ELIT)
  - QUALITY OF ECONOMIC AND POLITICAL INSTITUTIONS
  - TRADE
  - HUMAN INGENUITY – INVENTION AND INNOVATION = TECHNOLOGICAL PROGRESS ➔ **Creative destruction**
  - INVESTMENT IN BROAD CAPITAL

- „International variation in living standards that we observe today is a result of the long reach of history"

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