The role of spare time and inherited capacities for long-term growth

Hans G. Danielmeyer and Thomas Martinetz
Institut für Neuro- und Bioinformatik, www.inb.uni-luebeck.de

Sputnik 1958: biggest G7 technology push (Route 128, Silicon Valley…)
1975 to date: biggest G7 performance push (all-inclusive monetarism for profit, shareholder value, lean management…)
No shortage of labor, capital, resources
Result: continuous decrease of G7 growth rate to financial crash of 2008
China grows since 1980 with 10 % p.a.

F. Schweitzer: Krugman 08 “how did economists get it so wrong?”
J. E. Stiglitz: Crisis, Contagion, and the Need for a new Paradigm
D. Helbing: Rethink Macroeconomics!
The main deficit and a new paradigm

The main deficit: no information on demand beyond existential needs

User values are emotional, multiply overlapping, not additive like costs:
Advertising & short term prediction with dozens of indicators are big business,
but socioeconomic policy is reduced to correcting its own mistakes unless
medium and long-term demand is known.

This deadlock seems hopeless.

Live with the deficit, install financial controls, correct permanently the
distribution of goods, services, and wealth
or
find the broad solution:

understand human demand, quantify equilibrium, and
let investment and production serve human demand
Physics tradition: Symmetry helps detecting hidden quantities
Conditions for long-term predictions: no extrapolation of data, no curve fitting, no adjustable parameters, no approximations.
Instead:
Find compatible counterparts for production variables working time $w(t)$ and physical capital $k(t)$ – the GDP $y(t)$ is produced and used.
Set up intrinsic relations between all variables
Hope for analytic solutions
Get the system‘s parameters from the entire pattern of data

Civil War 1861, WWI, Great Depression, WWII, 2008: the theory‘s existence may be its best support, but it perfectly reproduces all peaceful data
New data I: GDP per capita and unisex life expectancy
New data II: \( w(t) \) and time shifts between normalized \( y(t), k(t) \)

A new quantity exists:

Human capacity \( h(t) \)

\[ E \log(1+G/E) = 21 \text{ yrs} \]
\[ E = 62 \text{ years} \]

First measurement of physical lifetimes

Physical capital \( k(t) \)

\[ \frac{1}{\beta} \log(1+\beta G) \]
\[ G = 25 \text{ years} \]
The data reveal 12 new facts:

Economic growth is S-functional. (S-functions show lifetimes of storable quantities with time shifts like Sinus-functions show them with phase shifts)

Recovery of from disasters is dominated by destructible physical capital $k(t)$. Its effective physical lifetime is $G=25$ years: the “generation constant“

Recoveries converge into the “industrial evolution” $a(t)$, not with the GDP of the leading world power.

An indestructible, so far hidden quantity must exist: human capacity $h(t)$ with a reaction time of $E=62$ years to change: the “evolution constant“

The working time $w(t)$ decreases anti-correlated with $a(t)$, confirming that $w(t)$ is designed into $k(t)$ according to the state of the art (industrial experience)

The mean life expectancy $L(t)$ of the pioneering nations runs parallel to $a(t)$

Both are immune to short term disasters

$L(t)$ is the average of the linear integral over $a(t)$ as existential condition

The precedence of $L(t)$ over $a(t)$ is half the final life expectancy of $L=118$ years

10 facts on human capacity $h(t)$, the counterpart of $k(t)$

The hidden storable quantity with the reaction time $E$ connects 3 generations
We name it human capacity $h(t)$. It is per capita indestructible
It organizes and amplifies spare time at home* for enjoying G7 affluence
like $k(t)$ organizes and amplifies $w(t)$ for producing G7 affluence

*not to be mixed up with “human capital“ used occasionally for the value of the work force

The conscious value of $h(t)$ follows from the cost of education.
Its inherited parts have no economic value since they come without extra cost.
They acquire economic value with the same mix of emotional and educated decisions that prevents us from quantifying demand beyond our existential needs.
We know this mix from daily life, behavioral tests, and games
It includes the unique human talent and desire for improving existential conditions,
but also our generically limited adaptability to an ever increasing affluence

$h(t)$ controls $a(t)$ and $L(t)$. It is the natural counterpart of $k(t)$.
Since money is not subject to the laws of nature it cannot calibrate physical values.
The only non-inflationary quantity is $L(t)$. It is to a relevant extent heritable:
Spare time $s(t)$, the counterpart for $w(t)$

$s(t)$ was so far ignored because it has no economic value, but G7 life would be unbearable without it. Physically it is as important as $w(t)$ because mankind has always the (free?) choice of producing more or having more time for enjoying whatever it produces.

$w(t)$ decreased from its agricultural maximum of 96 hours/week (16 hrs/day except Sundays) to an effective 35 hrs/wk in the G7. Taking the maximum as measuring unit for $s(t)$ and $w(t)$ yields

the inescapable global trade-off $s + w = \bar{\varepsilon} = 1 \, p.a. = 96 \, hrs / wk$
The first equilibrium condition between demand and supply

For the G7 only the part \( h_s \) of \( h(t) \) is actually used for \( s(t) \), and

only \( k_w \) of \( k(t) \) for \( w(t) \). Linear amplification yields

\[
(\overline{e} - w) h_s = y = w k_w
\]

\[
w = \frac{\overline{e}}{1 + k_w / h_s} \quad \text{and} \quad \frac{1}{y} = \frac{1}{\overline{e} h_s} + \frac{1}{\overline{e} k_w}
\]

depends on a medium
and a long-term quantity:
labor policy is tricky!

No adjustable parameter, 3 equations for \( h_s \): all other quantities are known

\[
\text{For the G7:} \quad h_s = 1.3 \, a / \overline{e}, \quad h \approx 3.7 \, a / \overline{e} \text{ from } h/E = \nu y
\]

\( h_s \) is very inelastic to \( k_w = \mu_w \, G \, a > h_s \) : biologic adaptability
The intrinsic relation for $k(t)$

The total national support for $k(t)$:

$$k/G = \mu(t)y : \quad \dot{k} + k/G = \mu (1 + G \dot{y}/y) y + \mu G y = \bar{\mu} y + \mu G y$$

Neglecting the last term in 1956 misled to exponential growth. It is the only endogenous term, duplicates $k(t)$ just with money, increases the capital coefficient $k/y$, and will cause the largest financial disaster of all times with China’s convergence into $a(t)$.

$$y = \bar{a}/(1 + e^{(T-t)/E} + e^\beta(\tau-t)), \quad \beta = (\bar{\mu}/\mu_o - 1)/G$$

$$k = \bar{\mu}G \bar{a}/(1 + e^{(T+21-t)/E} + e^\beta(\tau+\Delta\tau-t)), \quad \Delta\tau = \beta^{-1} \text{Log}(1 + \beta G)$$

$$\bar{a} = 75.000 \text{ US$} (1991), \quad T = 2040$$

$$L = L_o + (\bar{L} - L_o)/(1 + e^{(1981-t)/E}), \quad a(t) = \bar{a}/(1 + e^{(T-t)/E})$$

$E$, $G$, and $\bar{L}$ are constants of the human species.
Conclusions

The educated part of $h(t)$ allows mankind its unique position.
Its inherited part controls the limited adaptability to affluence.
Adam Smith’s “invisible hand” exists – in every individual

Some people reject this biologic fact
John Maynard Keynes 1930 (Great Depression): “The economic needs of mankind will soon be satisfied for the majority of the people. But some people want power over other people…and money is their peaceful tool.”

During the “Chicago Monetarism” politics lost its power to banks
They can earn good money only with giving credit for real investment
This theory predicts the demand for real investment

The human genome is indestructible. It stores and stabilizes Terabytes
Physical capital is destructible. It stores Megabytes
Money is destructible. It stores and stabilizes nothing

Even mankind cannot change its existential conditions faster than its generic adaptability allows