

I. Inequality and global integration

1. Global inequality

“One of the most neuralgic issues in the debate about globalization in recent years has been whether or not it has been unfair. The ‘pro’ camp argues that the decades since 1980 have brought about the biggest reduction in inequality the world has ever experienced. The ‘anti’ camp argues that globalization has helped a few prosper but left behind the majority, leading to the greatest degree of inequality in history. Both hold some truth, depending on how you look at inequality. In particular, there is a distinction between inequality within countries and inequality between countries. Starting with the latter, and looking at average income per capita nation by nation, countries such as the United States and United Kingdom have pulled much further ahead of the poorest countries such as Zimbabwe and Niger. At the same time, there has been a huge rise in average income per capita in China and India such that they have narrowed the gap with the richest countries. This latter development means global inequality has decreased substantially, but inequality within nations has not.”

2. Why inequality increases

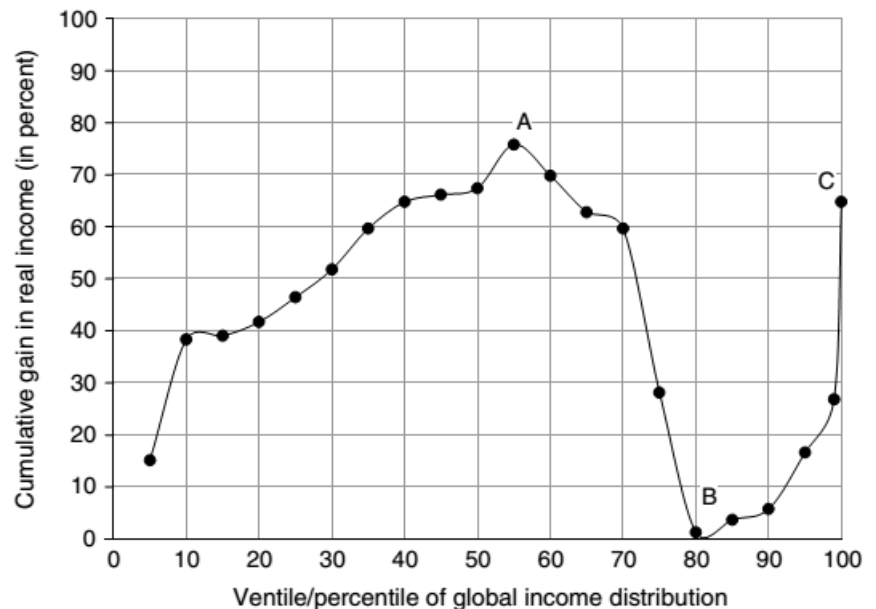
“...there are two main possible explanations for the development of greater inequality compared with the previous economic epoch. One is globalization, in effect bringing a large new source of cheap labor into the domestic economy; either through cheap imports or the offshoring of production, domestic workers have to compete with workers elsewhere who work for much lower wages (although they are also less productive). This could explain downward pressure on blue-collar wages or the low pay in basic services such as call centers (...) The other potential explanation is the adoption of new technologies requiring skills that were initially in short supply. Companies that use computers and other new technologies need people with greater cognitive abilities—computers can do the easy, repetitive work, so the humans need to do the more challenging and creative work. This is great news in the sense that a lot of dull jobs have gone and work for many has become more interesting, but it has substantially reduced the demand for workers with only basic qualifications, and swaths of formerly well-paid shop floor jobs have vanished (...) On balance, however, the technical change explanation emerges as the most important driver of increasing income inequality.”

“... structural changes in the economy driven by new technologies are the fundamental driver of greater inequality, in much the same way that the wave of innovation of early capitalism in the nineteenth century led to great inequality until the workforce as a whole developed the new skills that were needed. Technology has interacted with globalization to exacerbate the trend toward greater inequality, contributing to income inequality within countries through the move of low and medium skill jobs overseas, and creating a rich global elite. The failure of some of the poorest countries to participate at all in these economic trends has made greater inequality a global phenomenon.”

Coyle, Diane (2011): *The economics of enough. How to run the economy as if the future matters*, Princeton University Press, Princeton, New Jersey.

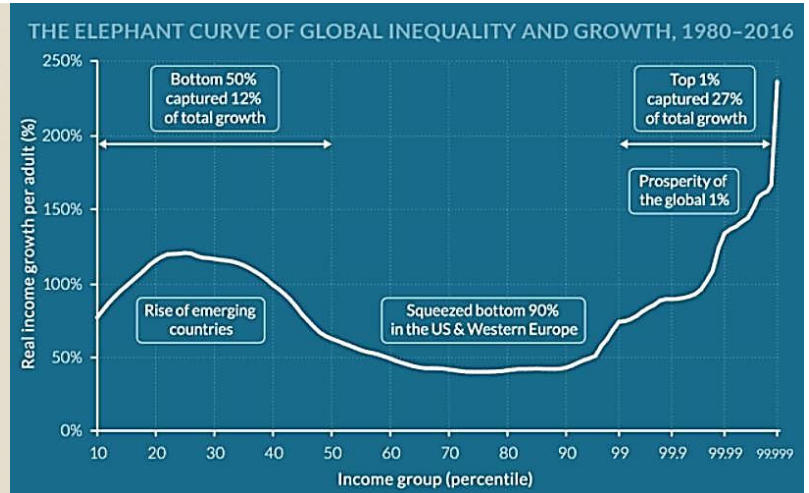
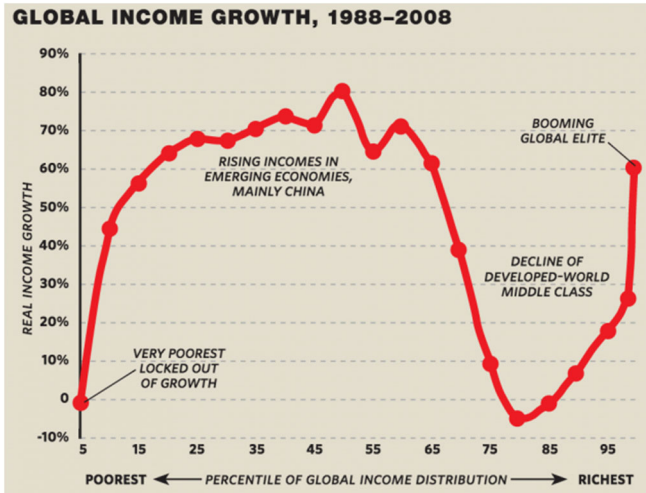
3. The gains from globalization are not evenly distributed: relative gains

The elephant curve on the right shows the percentual gain in real per capita income between 1988 and 2008 (the high globalization period). The horizontal axis ranks people in the world from the poorest (extreme left) to the richest (extreme right). The maximum gain (point A) is near the median (people slightly above the 50th percentile of the global income distribution) and for the richest (the top 1%, point C). The



minimum gain (point B) corresponds to the global 80th percentile (most of it in the lower middle class of the rich countries).

- **Beneficiaries of globalization (1988-2008).** (1) People between the 40th and the 60th percentile (1/5 of the world population). Most members in this group belong to Asian economies (China, India, Thailand, Vietnam, and Indonesia): the emerging global middle class. Hence, the Asian poor and middle classes define the great winners of globalization. (2) The global very rich (the global plutocrats).
- **The least benefited from globalization (1988-2008).** (1) The global poor (located in the countries that are not rich). (2) The global lower middle classes (most of whom live in the rich countries). Thus, the great

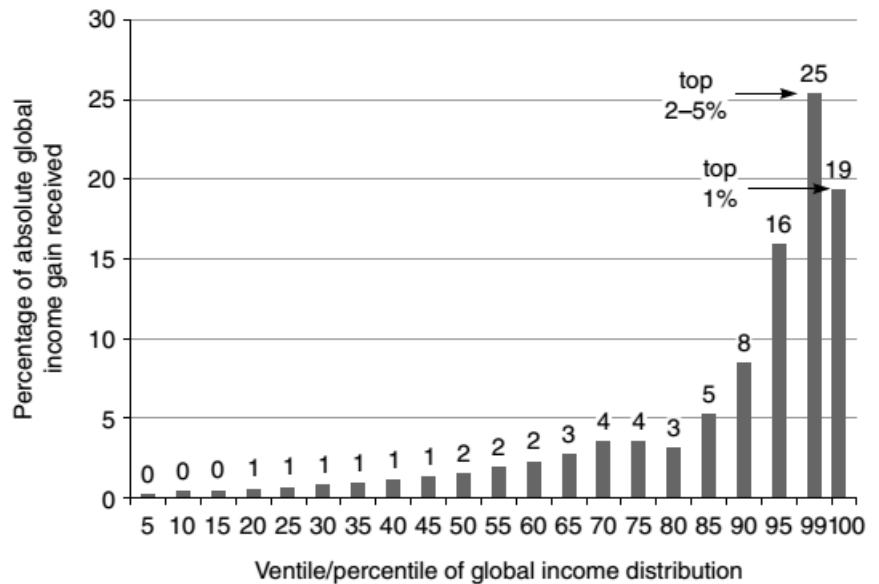


losers of globalization are the lower middle classes and the poorer segments of the rich world.

<http://prospect.org/article/worlds-inequality> wid.world/wp-content/uploads/2018/01/ElephantCurve.pdf

4. The gains from globalization are not evenly distributed: absolute gains

The chart on the right shows how the total increment in income between 1988 and 2008 has been distributed by global income level. It indicates that around the 44% of all the gains has been received by the richest 5% of the world population (the top 1% receiving 19% of the income rise). The other beneficiaries of globalization (the emerging global middle class) pocketed only between 2 and 4%.



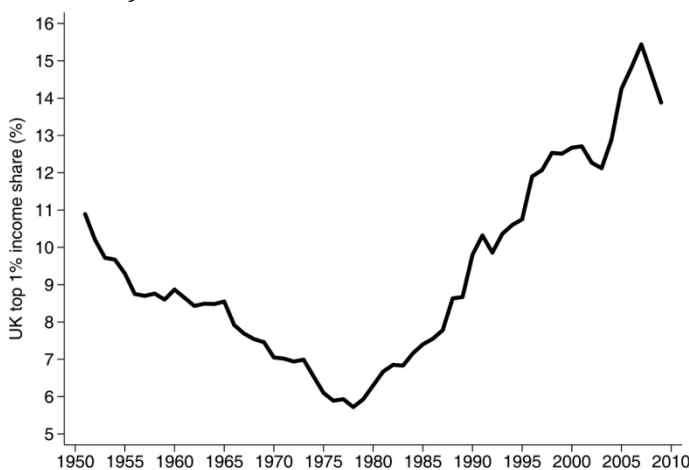
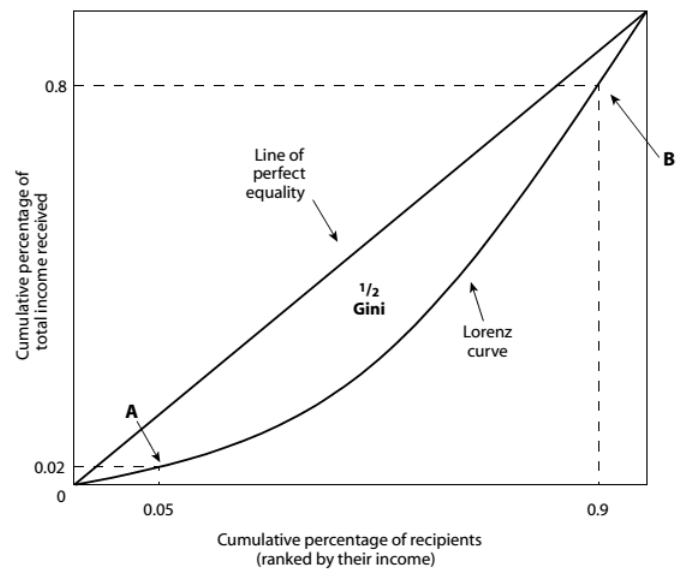
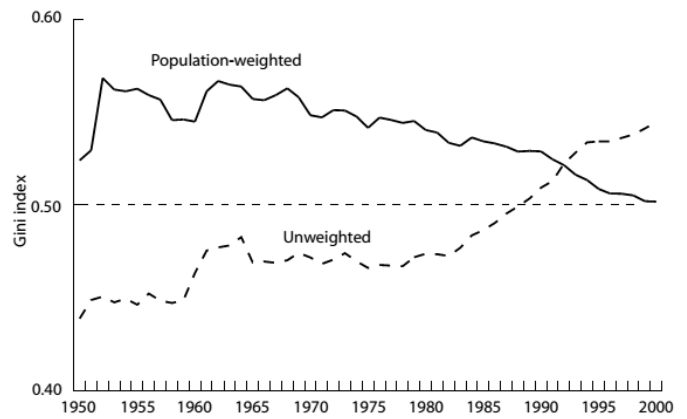
- **Top 1%.** According to Oxfam (16 January 2017), the eight richest men in the world together have the same amount of wealth (\$426 billion = 0.16% of the world's wealth) as the poorest 50% of the world population.
- **\$426 billion.** Spending one dollar per second (\$86,400 per day), it would take more than 13,500 years to exhaust \$426 billion.

https://www.oxfamamerica.org/static/media/files/170105_bn-economy-for-99-percent-160117_embargo-en.pdf

5. Inequality concepts

- **Concept 1 of inequality: unweighted international inequality.** Concept 1 associates with each country a representative individual, who is assigned the country's GDP per capita. Concept 1 actually compares countries, with all of them given the same weight.

- **Concept 2 of inequality: population-weighted international inequality.** As Concept 1, it is assumed that every person in a country receives the same income (the country's GDP per capita), but now the number of representative individuals attributed to each country depends on the country's size. Concept 2 ignores inequality within countries.
- **Concept 3 of inequality: individual international inequality.** In Concept 3 inequality measures are determined directly on individuals, all individuals in the world, with each individual counting the same.
- **Divergent measures of inequality.** The chart above shows two interpretations of the same reality: according to Concept 1, international inequality has increased (upward trend) in the last decades; whereas Concept 2 suggests a fall (downward trend). The difference: the behaviour of China and India (reduction in inequality essentially limited to a few big countries).
- **Gini coefficient (Corrado Gini).** It is a measure of inequality (and income distribution) going from 0 (maximum equality) to 1 (maximum inequality: a single individual receives all the income). The Gini index is the coefficient in percentages. Graphically, it is (twice) the area between the line of perfect equality (the main diagonal) and the Lorenz curve (which charts the proportion of total income received by the cumulative proportion of recipients ranked by their per capita income from poorer to richer; in the graph on the right, point A means that the poorer 5% of individuals receive the 2% of total income).



Milanović, Branko (2007): *Worlds apart: Measuring international and global inequality*, Princeton University Press, Princeton, NJ.

The rise of the super-rich in the UK (McQuaig, Linda; Neil Brooks (2013): *The trouble with billionaires: How the super-rich hijacked the world (and how we can take it back)*)

6. Inequality myths

- **Myth 1:** Inequality is a necessary counterpart of economic dynamism and competitiveness. According to this myth, rising inequality is an inevitable consequence of rapid economic growth (or a necessary condition for competitiveness). Policies that lower inequality, it is claimed, reduce the incentives to work hard and innovate.
- **Myth 2:** The best way to help the poor is to help the rich ("Equity needs growth").
- **Myth 3:** Inequality is actually not a problem as long as extreme poverty is avoided and incomes are all rising ("the rising tide lifts all boats").

- **Myth 4:** As pay is related to ability, rising inequality is just the result of increasing differences in people's ability (I am paid more because I am worth it).

Sudhir Thomas Vadaketh; Donald Low (2014): *Challenging the Singapore Consensus.*

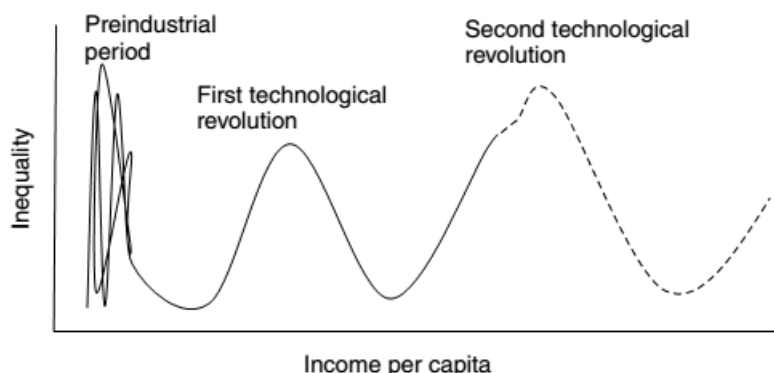
7. The Kuznets curve (or hypothesis)

The Kuznets curve is the conjecture (by Simon Kuznets) relating the level of economic inequality with the level of real income. Graphically, it takes the form an inverted U: for low income levels, inequality is low; as income grows, inequality increases; and, from some sufficiently high income level on, inequality decreases. However, the recent experience of the advanced economies shows that inequality need not decrease with development.

8. The Kuznets wave (or cycle)

The Kuznets wave is the conjecture (Branko Milanović) that there are waves of alternating increases and decreases in inequality in time (as income increases).

- Before the Industrial Revolution inequality undulated around a fixed average income level (in a Malthusian cycle the source of the fluctuation in inequality is demographic: an income rise lower inequality and triggers a population increase among the poor; with a decreasing marginal productivity of labour, a larger population leads to a fall in productivity and income, which increases inequality and moderates population growth).
- The Industrial Revolution made possible a sustained growth of income and also an increase in inequality. First, because higher incomes create the potential for more inequality. Second, because structural changes in the economy (urbanization, rising importance of the industrial sector) drove up inequality. Inequality eventually decreased when the supply of more educated workers increased and economic policies responded to pressures to correct the unevenness of the distribution of income (the welfare state). Military conflicts and political revolutions (themselves often consequences of excessive inequality) also contributed to the reduction in inequality. The 'Great Leveling' refers to the reduction in inequality in the richer countries between 1945 and 1980.
- A new technological revolution affected the rich countries in the 1980s (digital revolution) by widening income disparities. The new technologies rewarded the more skilled workers, pushed up the return to capital and made the less skilled worker suffer the strong competition from China and India. The service sector increased in importance, with many of the new jobs not requiring much qualification and being badly paid. Moreover, pro-rich economic policies tended to be universally adopted.



Milanović, Branko (2016): *Global inequality: A new approach for the age of globalization, Harvard University Press, Cambridge, MA.*

9. How to reduce inequality

Extreme inequality can be solved through the tax system. The mechanisms involved in the first reduction were increased taxation, social transfers, hyperinflation, nationalization of property and wars. Globalization makes more difficult to raise taxation on capital income: it is harder to tax a mobile capital. The rich are also resistant to the application of redistributive measures (neoliberalism and trickle-down economics). And one of the apparent characteristics of globalization is that the winner takes all.

10. Piketty's $r > g$ theory of inequality: the fundamental force of divergence

The symbol r stands for an average rate of return on holdings of wealth over long periods (average return of stocks, corporate bonds, savings accounts, government bonds, real estate, other financial assets...). The symbol g is the GDP growth rate and can be interpreted as the average speed at which incomes in a economy grow. Piketty's theory (the fundamental inequality of capitalism) is that inequality increases when r grows faster than

g . With $r > g$, wealth grows more than income; and as wealth is distributed more unequally than income, a faster growth of wealth with respect to the growth of income contributes to an increase in inequality: the rewards to the owners of wealth are larger than the income that, on average, generates the economy.



$$Y = W + P$$

aggregate income = salaries + profits

$$r = \frac{P}{K}$$

rate of return = profits / capital

$$K' = K + I$$

capital tomorrow = capital today + investment

$$I = s \cdot Y$$

investment = savings rate · income

$$Y' = (1 + g) \cdot Y$$

income tomorrow = (1 + income growth rate) · income today

Let $\alpha = \frac{P}{Y}$, $\beta = \frac{K}{Y}$ and $Y = \frac{Y}{L} \cdot L$, where L is population and $\frac{Y}{L}$ is average productivity. Therefore, $g \approx \lambda + n$: income growth is approximately equal to productivity growth plus population growth. As $\frac{P}{Y} = \frac{Y}{K} \cdot \frac{K}{Y}$, it follows that $r = \alpha/\beta$ or, equivalently,

$$\alpha = r \cdot \beta$$

which Piketty calls “the first fundamental law of capitalism”. Moreover,

$$\frac{K'}{Y'} = \frac{K + I}{Y'} = \frac{K}{Y'} + \frac{I}{Y'} = \frac{K}{(1 + g) \cdot Y} + \frac{s \cdot Y}{(1 + g) \cdot Y} = \frac{1}{1 + g} \cdot \frac{K}{Y} + \frac{s}{1 + g}$$

At a stationary state, $\frac{K'}{Y'} = \frac{K}{Y} = \beta$. Hence, solving for β , it is obtained Piketty’s “second fundamental law of capitalism” or dynamic law of accumulation:

$$\beta = \frac{s}{g} \approx \frac{s}{\lambda + n}$$

A falling share $\frac{W}{Y}$ of wages in income can be interpreted as a rise in inequality: capital gets an increasing larger portion of income. From $Y = W + P$, $1 = \frac{W}{Y} + \frac{P}{Y} = \frac{W}{Y} + \alpha$. As a result,

$$\frac{W}{Y} = 1 - \alpha = 1 - r \cdot \beta = 1 - \frac{s \cdot r}{g} \approx 1 - \frac{s \cdot r}{\lambda + n}$$

The above equation indicates that the wage share $\frac{W}{Y}$ decreases (inequality goes up) when:

- (i) the savings rate s rises;
- (ii) the rate of return r rises;
- (iii) the rate of growth λ of labour productivity falls;
- (iv) the rate of growth n of population falls; or
- (v) the rate of growth g of the economy declines (this is a combination of (iii) and (iv)).

11. Forces of convergence and divergence of market economies

With a constant s , the dynamics of inequality is explained by the evolution of the private rate of return r on capital and the rate of growth g of income. Having $r > g$ implies that wealth accumulated in the past grows faster than income (and wages). That capital tends to expand itself more rapidly than the economy is the principal force of divergence (inequality). The diffusion of knowledge and skills is a powerful force of convergence (and social stability). Globalization seems to have favoured so far the forces of divergence: the narrowing of income

inequality between countries has been relatively small (look at the Earth at night, or page 7: light = prosperity; darkness = poverty).

12. Piketty's claims

- The growth (or contraction) of an economy's wealth-to-annual-income ratio ($\beta = K/Y$) is the quotient s/g between the net savings (the accumulation rate) and the economy's growth rate.
- Wealth is eventually concentrated in the hands of a small group: the larger β , the more unequal the distribution of wealth.
- An unequal distribution of income is the consequence of an unequal distribution of wealth: the privileged small group will steer political decisions on their behalf, to prevent the rate of profit from falling.
- The privileges of the small group will be preserved through inheritance.
- When wealth is inherited, the small privileged group will possess great influence (politically, economically, socioculturally) that will most likely be exercised to the detriment of the majority.

"The process by which wealth is accumulated and distributed contains powerful forces pushing toward divergence, or at any rate toward an extremely high level of inequality (...) It is possible to imagine public institutions and policies that would counter the effects of this implacable logic: for instance, a progressive global tax on capital. But establishing such institutions and policies would require a considerable degree of international coordination." (Piketty, 2014, p. 27)

Piketty, Thomas (2014): *Capital in the twenty-first century*, Belknap Press, Cambridge, MA.

Dickens, Edwin (2015): "Piketty's Capital in the Twenty-First Century: A review essay", *Review of Political Economy* 27(2), 230-239.

López-Bernardo, Javier; Félix López-Martínez; Engelbert Stockhammer (2016): "A Post-Keynesian Response to Piketty's 'Fundamental Contradiction of Capitalism'", *Review of Political Economy* 28(2), 190-204.

13. A new country: Richistan

"(In the US) The rich weren't just getting richer; they were becoming financial foreigners, creating their own country within a country, their own society within a society, and their economy within an economy. They were creating Richistan." There are four classes in Richistan.

- **Lower Richistan.** Some 7 million households with net worth \$1-10 m. "Most of them are welleducated, work-a-day professionals: corporate executives, doctors, lawyers, bankers, designers, analysts and money managers. More than half their wealth is derived from income, with another third coming from investment returns. In an increasingly global, hightech, finance-oriented economy, Lower Richistanis have benefited from the growing demand for highly educated workers and rising pay at the top."
- **Middle Richistan.** It includes more than 2 million households, with net worth between \$10 m and \$100 m. "Most Middle Richistanis make their money from salaries, small businesses or investment returns. As you move from Lower to Upper Richistan, however, the number of entrepreneurs and business owners starts to increase. Middle Richistan has twice as many entrepreneurs as Lower Richistan, showing that the surest path to big wealth is starting your own company and selling it."
- **Upper Richistan.** It includes thousands of households, with net worth at least \$100 m. "Most made their money by starting their own companies and selling them, although CEOs and money managers (especially hedge funders) are rapidly joining the ranks. The lives of Upper Richistanis have become incredibly complicated. To run them, they're creating 'family offices'—large companies dedicated entirely to serving a family's day-to-day needs, from investments and legal work to travel plans and hiring house staff (...) When you live in Upper Richistan, your entire philosophy of money changes. You realize that you can't possibly spend all of your fortune, or even part of it, in your lifetime and that your money will probably grow over the years even if you spend lavishly. So Upper Richistanis plan their finances for the next hundred years."

- **Billionaireville.** With 13 inhabitants in 1985, it had more than 400 in 2006. “The personal lives of billionaires are more like companies. Their homes are like hotels—sprawling campuses with their own logos, purchasing budgets and legions of staff. Ask a billionaire for his or her bank statement and you’ll get a five-level flowchart of interlocking subsidiaries, holding companies, investment funds and foundations.”

Frank, Robert L. (2007): *Richistan. A journey through the American wealth boom and the lives of the new rich*, Crown Publishers, New York.

14. Inequality trends (in the US)

“While US inequality is part of a global trend, the condition is more acute due to the nature of hyperindividualistic capitalism and public policy in this country.”

- “One of the most important trends (...) is the persistent stagnation of wages since the 1980s. After a period of relative shared prosperity, between 1947 and 1977, when real wages doubled for every stratum of US society, we entered a phase of flat or falling paychecks for a majority of US wage earners. Since 1975, there have been extraordinary gains in productivity. But over half of US wage earners have not shared in the fruits of their labors. In 1970, the bottom half of wage earners, roughly 117 million adults, made an average of \$16,000 a year in current dollars. By 2014, earnings for the bottom half of households had remained virtually unchanged, bumping up slightly to \$16,200. Over the same period, the incomes of the top 1 percent tripled, from average annual wages of \$400,000 to \$1.3 million.
- The result is persistent poverty at the bottom, a work treadmill for low-wage workers, and a squeeze on middle-class workers. For more than four decades, poverty rates have remained unchanged. Over 13.5 percent of the population, an estimated 43 million people, live below the poverty line.”
- “Another form of income inequality is the increasing gap between the compensation of CEOs and top corporate executives compared to average- or lowest-paid workers in firms. In the mid-1960s, the ratio between CEO pay and average worker pay was about 20:1. In recent years, the ratio has swollen to more than 300:1. Skyrocketing CEO pay is one of the drivers of increased income concentration.”
- “Another alarming trend has been the updraft of both income and wealth to the very wealthiest households. Between 1980 and 2013, the richest 1 percent saw their average real income increase by 142 percent, with their share of national income doubling from 10 percent to 20 percent. But most economic gains during this period have flowed to the top 0.1 percent – the top one-tenth of 1 percent – whose real income increased by 236 percent. Their share of national income almost tripled, from 3.4 percent to 9.5 percent. Since the economic meltdown of 2008, an estimated \$91 of every \$100 in increased earnings have gone to the top 1 percent (...) Wealth has increasingly concentrated at the top. The wealthiest 1 percent of households now hold roughly 42 percent of private wealth, up from 33 percent in 1983. At the very pinnacle of US wealth is the Forbes 400 (...) with a combined net worth of \$2.3 trillion. Together, this group has more wealth than the bottom 62 percent of the US population combined. The 20 wealthiest billionaires (...) have more wealth than the entire bottom half of the US population.”
- “One reason the wealthy have so much more than the bottom half of US households is that almost 20 percent of US households have zero or negative net worth.”
- “Reflecting the historic inequalities between white, black, and Latino households, the racial wealth divide has grown over the last several decades. In 2013, the median wealth of white households was an alarming 13 times greater than the median wealth of black households —up from 8 times greater in 2010. White households had 10 times more wealth than Latino households. The richest 100 billionaires have more wealth than the entire African American population (...) 42 million people. The wealthiest 186 billionaires have as much wealth as the entire Hispanic population: more than 55 million people.”
- “Inequality in America is reversible (...) The policy agenda described in this book —such as eliminating student debt, expanding good jobs through green infrastructure, establishing a universal basic income, and expanding homeownership and wealth-building opportunities— are examples of big interventions that will reverse inequality (...) Reversing inequality is not only possible. It is the only path forward.”

Collins, Chuck (2018): *Is inequality in America irreversible?*, Polity Press, Malden, MA.

15. Two views on the impact of globalization on world income (Erik S. Reinert, 2004, p. 1)

- Orthodox view (Paul Samuelson). Unrestricted international trade leads to factor-price equalization: the prices paid to the production factors (capital, labour) will tend to converge around similar values around the world. In particular, wages in poor countries should converge to wages in rich countries.
- Heterodox ('the other canon') view (Gunnar Myrdal). International trade reinforces existing income differences between richer and poorer economies. In this view, the gains from trade are not symmetrically distributed. For example, economies accumulating more human capital are in better position to attract more physical capital, which will become more productive in those economies and will increase the accumulation of human capital there.

Reinert, Erik S.; ed. (2004): *Globalization, economic development and inequality. An alternative perspective*, Edward Elgar, Cheltenham, UK.

16. Is inequality the norm?

"This book began with a simple observation: virtually all human societies are marked by inequality, at a level that surpasses what could be expected from normal differences in individuals' capabilities alone."

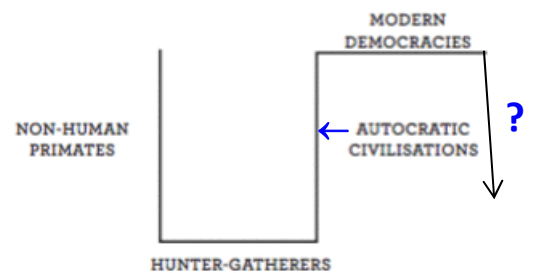
"Small deviations from total equality will increase with time. If property and assets can be inherited, inequality will also intensify from generation to generation (...) Success in competition is not always determined by the traits or behavioral patterns that we would prefer to associate with success."

"The reason why policies of redistribution in the Nordic countries during the twentieth century were successful is that a broad spectrum of instruments were used—education, labor market policy, social insurance, taxes, and transfers. The discussion around the work of Thomas Piketty and his colleagues has been dominated by the issue of capital taxation, which is too narrow a perspective. Certain of the above instruments have become more difficult to use as a result of globalization, whereas national governments retain full authority over education and labor market policy."

Molander, Per (2016): *The anatomy of inequality*, Melville House, Brooklyn and London.

17. U-shaped/saucepan curve of hierarchical/egalitarian societies

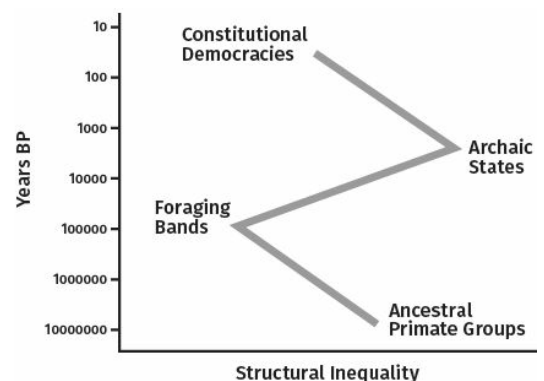
The U-shaped curve captures "the puzzling fact that most non-human primate species live in extremely hierarchical groups (a vertical line), whereas early human beings lived in remarkably egalitarian mini-societies (a horizontal line) — and civilised human beings, for the most part, have reverted to extreme hierarchies (another vertical line, and thus a U-shaped curve) (...) The puzzle was not just a U-shaped curve. It was more like the cross-section of a saucepan, and the (horizontal) saucepan handle was what had happened over the past two-and-a-half centuries in the West and was happening all around the planet right now: the re-emergence of egalitarian values in politics and the spread of democratic systems in modern mass societies."



Dyer, Gwynne (2018): *Growing pains. The future of democracy (and work)*, Scribe, Melbourne and London.

18. Zigzags in the evolution of human equality

"Our Great Ape ancestors lived in hierarchical societies. We believe this because our closest relatives, chimpanzees, bonobos, and gorillas, all live in societies with very strong dominance hierarchies (...) Early humans broke the pattern, evolving a reversed dominance hierarchy whose goal was to suppress potential alpha males. This worked for tens of thousands of years—until the adoption of agriculture and the rise of the first centralized polities allowed the alpha male to resurface with unfettered power in archaic states that were the most despotic societies in which people



have ever had the misfortune to live (...) The second turn, away from despotic archaic states, is much more ancient than might be supposed—the Axial Age, rather than the Age of Enlightenment (...) The military revolution of 1000 BCE that began deep in the Eurasian steppe triggered momentous developments in the belt of agrarian societies stretching from the eastern Mediterranean to China. The new ideologies—Axial religions—introduced a number of cultural innovations that buttressed our capacity for cooperation in large groups. These innovations included social norms and institutions that constrained rulers to act in less selfish and despotic ways.”

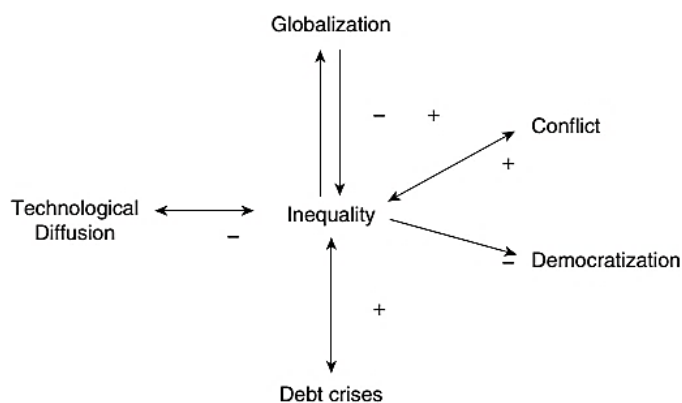
Turchin, Peter (2016): *Ultrasociety: How 10,000 years of war made humans the greatest cooperators on Earth*, Beresta Books, Chaplin, Connecticut.

19. The Iron Law of Oligarchy (Robert Michels, 1911)

“All forms of organization, regardless of how democratic or autocratic they may be at the start, will eventually and inevitably develop into oligarchies.”

20. North-South Gap (North-South Divide)

The North-South Divide refers to the fact that most rich and developed countries lie above the equator and most of the least developed and poor countries lie below. So far there is no solid evidence of a substantial move towards global convergence (apart from already affluent economies). The world still appears divided between a minority of rich countries (the Pacific North) and a majority of poor or semi-poor countries (the conflictual South). The sketch on the right (taken from Thompson and Reuveny, 2010, p. 3) summarizes the basic processes that contribute to preserve the North-South divide (‘-’ means negative relationship, ‘+’ positive relationship).



- **Is globalization consolidating the North-South divide (the rich-poor dichotomy, the centre-periphery division) created by the Great Divergence?** Since the development of the rich countries depends on an increasing use of resources, is it not in the interest of the richer countries to keep the poorer countries poor and weak, so that it will be easier to take from them the resources the rich countries need?

21. Poor economics

“To progress, we have to abandon the habit of reducing the poor to cartoon characters and take the time to really understand their lives, in all their complexity and richness (...) The average poverty line in the fifty countries where most of the poor live is 16 Indian rupees per person per day. People who live on less than that are considered to be poor by the government of their own countries. At the current exchange rate, 16 rupees corresponds to 36 U.S. cents. But because prices are lower in most developing countries, if the poor actually bought the things they do at U.S. prices, they would need to spend more—99 cents. So to imagine the lives of the poor, you have to imagine having to live in Miami or Modesto with 99 cents per day for almost all your everyday needs (excluding housing). It is not easy—in India, for example, the equivalent amount would buy you fifteen smallish bananas, or about 3 pounds of low-quality rice. Can one live on that? And yet, around the world, in 2005, 865 million people (13 percent of the world’s population) did.”

“What is striking is that even people who are that poor are just like the rest of us in almost every way (...) Living on 99 cents a day means you have limited access to information—newspapers, television, and books all cost money—and so you often just don’t know certain facts that the rest of the world takes as given, like, for example, that vaccines can stop your child from getting measles. It means living in a world whose institutions are not built for someone like you. Most of the poor do not have a salary (...) It means going to vote when your entire experience of the political system is a lot of promises, not delivered; and not having anywhere safe to keep your money, because what the bank manager can make from your little savings won’t cover his cost of handling it. And so on.”

“It is not easy to escape from poverty, but a sense of possibility and a little bit of well-targeted help (a piece of information, a little nudge) can sometimes have surprisingly large effects. On the other hand, misplaced expectations, the lack of faith where it is needed, and seemingly minor hurdles can be devastating. A push on the right lever can make a huge difference, but it is often difficult to know where that lever is. Above all, it is clear that no single lever will solve every problem.”

Banerjee, Abhijit V.; Esther Duflo (2011): *Poor economics. A radical rethinking of the way to fight global poverty*, PublicAffairs, New York.

22. Are there poverty traps? Abhijit and Duflo’s S-shape curve

“Instead of discussing how best to fight diarrhea or dengue, many of the most vocal experts tend to be fixated on the ‘big questions’: What is the ultimate cause of poverty? How much faith should we place in free markets? Is democracy good for the poor? Does foreign aid have a role to play? And so on.

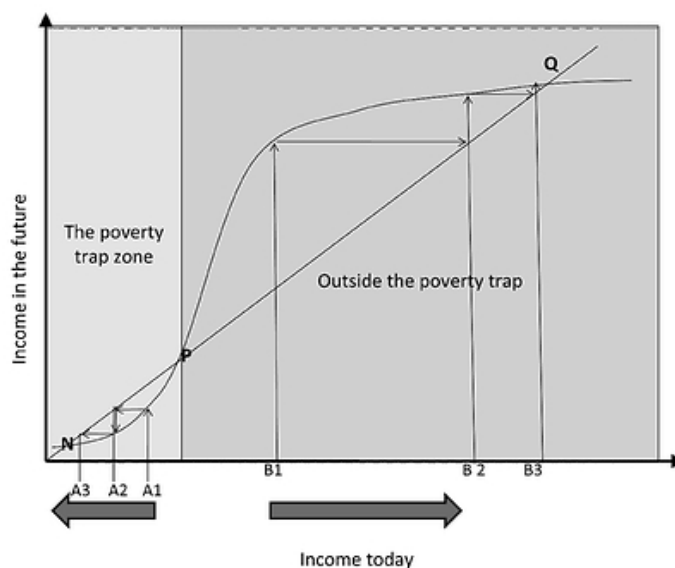
Jeffrey Sachs (...) has an answer to all these questions: Poor countries are poor because they are hot, infertile, malaria infested, often landlocked; this makes it hard for them to be productive without an initial large investment to help them deal with these endemic problems. But they cannot pay for the investments precisely because they are poor—they are in what economists call a ‘poverty trap.’ Until something is done about these problems, neither free markets nor democracy will do very much for them. This is why foreign aid is key: It can kick-start a virtuous cycle by helping poor countries invest in these critical areas and make them more productive. The resulting higher incomes will generate further investments; the beneficial spiral will continue.”

“But then there are others (...) who believe that all of Sachs’s answers are wrong. William Easterly (...) has become one of the most influential anti-aid public figures (...) [Easterly and Dambisa Moyo] argue that aid does more bad than good: It prevents people from searching for their own solutions, while corrupting and undermining local institutions and creating a self-perpetuating lobby of aid agencies. The best bet for poor countries is to rely on one simple idea: When markets are free and the incentives are right, people can find ways to solve their problems. They do not need handouts, from foreigners or from their own governments. In this sense, the aid pessimists are actually quite optimistic about the way the world works. According to Easterly, there are no such things as poverty traps.”

“This book will not tell you whether aid is good or bad, but it will say whether particular instances of aid did some good or not (...) the endless debates about the rights and wrongs of aid often obscure what really matters: not so much where the money comes from, but where it goes. This is a matter of choosing the right kind of project to fund—should it be food for the indigent, pensions for the elderly, or clinics for the ailing?—and then figuring out how best to run it.”

“... this discussion helps us see a general principle. There will be a poverty trap whenever the scope for growing income or wealth at a very fast rate is limited for those who have too little to invest, but expands dramatically for those who can invest a bit more. On the other hand, if the potential for fast growth is high among the poor, and then tapers off as one gets richer, there is no poverty trap.”

“For those who believe in poverty traps, the world looks like [the figure on the right]. Your income today influences what your income will be in the future (the future could be tomorrow, next month, or even the next generation): What you have today determines how much you eat, how much you have to spend on medicine or on the education of your children, whether or not you can buy fertilizer or improved seeds for your farm, and all this determines what you will have tomorrow. The shape of the curve is key: It is very flat at the beginning, and then rises rapidly, before flattening out again. We will call it (...) the *S-shape curve*. The S—shape of this curve is the source of the poverty trap.”



Banerjee, Abhijit V.; Esther Duflo (2011): *Poor economics. A radical rethinking of the way to fight global poverty*, PublicAffairs, New York.

23. Moral imperative to help the poor?

“The philosopher Peter Singer has written about the moral imperative to save the lives of those we don’t know. He observes that most people would willingly sacrifice a \$1,000 suit to rescue a child seen drowning in a pond and argues that there should be no difference between that drowning child and the 9 million children who, every year, die before their fifth birthday. Many people would also agree with Amartya Sen, the economist-philosopher and Nobel Prize Laureate, that poverty leads to an intolerable waste of talent. As he puts it, poverty is not just a lack of money; it is not having the capability to realize one’s full potential as a human being.”

“The main disagreement shows up when we turn to the question, ‘Do we know of effective ways to help the poor?’ (...) The point is simple: Talking about the problems of the world without talking about some accessible solutions is the way to paralysis rather than progress. This is why it is really helpful to think in terms of concrete problems which can have specific answers, rather than foreign assistance in general: ‘aid’ rather than ‘Aid.’”

24. Five lessons to improve the lives of the poor

“... although we have no magic bullets to eradicate poverty, no one-shot cure-all, we *do* know a number of things about how to improve the lives of the poor. In particular, five key lessons emerge.

First, the poor often lack critical pieces of information and believe things that are not true. They are unsure about the benefits of immunizing children; they think there is little value in what is learned during the first few years of education; they don’t know how much fertilizer they need to use; they don’t know which is the easiest way to get infected with HIV; they don’t know what their politicians do when in office. When their firmly held beliefs turn out to be incorrect, they end up making the wrong decision.”

“Second, the poor bear responsibility for too many aspects of their lives. The richer you are, the more the ‘right’ decisions are made for you. The poor have no piped water, and therefore do not benefit from the chlorine that the city government puts into the water supply. If they want clean drinking water, they have to purify it themselves.”

“Third, there are good reasons that some markets are missing for the poor, or that the poor face unfavorable prices in them. The poor get a negative interest rate from their savings accounts (if they are lucky enough to have an account) and pay exorbitant rates on their loans (if they can get one).”

“Fourth, poor countries are not doomed to failure because they are poor, or because they have had an unfortunate history. It is true that things often do not work in these countries: Programs intended to help the poor end up in the wrong hands, teachers teach desultorily or not at all, roads weakened by theft of materials collapse under the weight of overburdened trucks, and so forth. But many of these failures have less to do with some grand conspiracy of the elites to maintain their hold on the economy and more to do with some avoidable flaw in the detailed design of policies, and the ubiquitous three Is: ignorance, ideology, and inertia.”

“Finally, expectations about what people are able or unable to do all too often end up turning into self-fulfilling prophecies.”

Banerjee, Abhijit V.; Esther Duflo (2011): *Poor economics. A radical rethinking of the way to fight global poverty*, PublicAffairs, New York.

25. The new poverty trap of current globalization

This trap is the result of lacking adequate physical infrastructures, capital stock, educational achievement, appropriate institutions, governance skills and ability to control the domestic macroeconomic fundamentals in the presence of free flows of international capital. It contributes to the trap the enforcement of an institutional international order that favours the rich: transformation of global competition into positional competition (more importance of the trade in services and decommodified goods) and legal architecture that reinforces the leaders in the positional competition (protection to intellectual property rights and to the free mobility of capital).

26. Further remarks on inequality

- “Money flows across frontiers, but laws do not. The rich live globally, the rest of us have borders.”
- There is an “inevitable tension between borderless money and bordered states.”

- “In advanced countries increasing inequality is the result of three interacting factors: the strengthening of capital versus labour, increasing individualism and the withdrawal of the redistributive role of the state by decreasing taxes on high incomes, and reductions in the provision of public services through non-market systems, such as education , health, social security and pensions (...) In short, rising inequality has been caused mostly by huge gains made by the banking sector and the lowering of tax rates on higher incomes.”
- “The fundamental flaw of neoliberals is to have just a single and universal recipe for all problems and circumstances. This is too narrow a focus on curtailing the role of the state in the economy and the impediments to the flow of goods, capital and money across borders.”

Morrone, Mario (2018): *What is the truth about the Great Recession and increasing inequality? Dialogues on disputed issues and conflicting theories, Springer, Cham, Switzerland*

27. Something is not working... or is it working too well? (A. Coskun Samli, 2014)

“I am not surprised as much as I am shocked at how we have not learned much about the market economy for which we would go to war, for which we would run for office, for which we would spend billions of dollars so that we could gain political power. But we really don't know much about really what it is and how it works. If Adam Smith were alive, he would be screaming about the fact that there is nothing today that resembles what he advocated (...) These two gentlemen—Marx and Smith—would not have in their wildest dreams believed just what is happening in the United States and in fact in the world today.

In a broad sense, the market economy is there to provide products and services for the consumers so that they can improve their quality of life and take care of their problems as consumers. But what is happening in the United States and in the world, particularly in Europe, is something shockingly different. The masses are putting out their toil so that just a few lucky and privileged people will get richer. In 2010, 97 percent of total American GDP went to 1 percent of the American population. This is even worse than when all Russians worked for the Czars. This certainly is not what Adam Smith and Carl Marx thought or advocated.”

“The society is being run by financiers who truly are not givers or job creators but are ruthless takers who are motivated with their unchecked and uncontrolled greed (...) During the past three decades we moved (...) to [the principle] ‘let them get as much money as possible any way they can and let them keep it’ philosophy. Thus, many CEOs are making millions of dollars in salaries while the minimum wage is only about eight dollars (...) We, as a society, seem to be controlled by greedy CEOs. The military-industrial complex has made recent wars of choice a vehicle to make money for certain groups at the expense of the society.”

“But having said all this, the market system is the only mechanism that would create jobs, would distribute wealth, would generate economic growth, and stabilize the economy by benefiting the whole society, not only the privileged few. But that mechanism simply is not working.”

Samli, A. Coskun (2014): *Dynamic markets and conventional ignorance. The great American dilemma, Palgrave Macmillan, New York.*

28. Unequal distribution of trade gains: impact of trade liberalization on the labour market

There appears to be a general, theoretical consensus that trade liberalization creates gains at the macroeconomic level at the expense of generating losses at the microeconomic level. Specifically, trade liberalization makes low-skilled workers worse off: trade liberalization tends to destroy jobs requiring low or no particular skill and also tends to reduce the wages of these occupations (and, thus, increase income inequality). The unequal distribution of trade gains provides a reason for the adoption of public policies that compensate the groups harmed by trade without losing the trade gains. There are two main policy instruments to redistribute the gains.

- Use wage subsidies for low-skilled workers to offset or attenuate the wage decrease. This policy tool is rarely used.
- Use unemployment benefits to compensate the income that the unemployed no longer obtain from a job they no longer have. The theoretical claim is that this measure raises the average wage in the economy, which reduces the aggregate demand for labour and, as a result, aggregate production; that is, trade gains are partially lost. The funding of unemployment benefits is also a relevant issue. Are they financed by means

of: (i) a wage tax paid by workers; (ii) a payroll tax paid by firms; (iii) a profit tax paid by the exporting firms?

Marco de Pinto (2013): *International trade and unemployment. On the redistribution of trade gains when firms matter*, Physica-Verlag, Heidelberg, Germany.

Giancarlo Gandolfo (2014): *International Trade Theory and Policy*, Springer, Heidelberg, Germany, ch. 16-17.

29. Drivers of the globalization of labour markets

- 'The great doubling' of the global labour force, due to the entry of China, India and Russia in the global economy (nearly 1.5 billion additional workers between 1980 and 2000).
- The expansion of higher education in developing countries (increased by 383% between 1970 and 2000).
- The transfer of modern technology to developing countries.

30. Offshore outsourcing

A key driver of economic globalization is the rapid expansion of offshore outsourcing, itself facilitated by the increasing ability of companies to fragment production processes across national borders. As a result, the world has initiated a transition toward a single global economy.

31. The Great Transformation

Expression that refers to the creation, since around 1980, of a global labour market and the associated redefinition of the social order. The process is analogous to the rise of national market economies in the nineteenth and early twentieth centuries.

32. Winners and losers from the Great Transformation

- **Winners:** businesses that employ workers from developing countries and the workers in developing countries (mainly, China and India) employed by the modern (more productive) sectors.
- **Losers:** workers in other developing countries (manufacturing jobs in Latin America, Africa, and Asia have been transferred to China or India; some of these countries have benefited from an additional international demand for natural resources, but extraction industries employ relatively few workers and create basically low-skilled jobs). In both developing and developed countries, the creation of a global labour market is putting (mostly, low-skilled) workers in a more precarious position: offshore outsourcing give more privileges and negotiating power to businesses.

Paus, Eva; ed. (2007): *Global capitalism unbound. Winners and losers from offshore outsourcing*, Palgrave Macmillan, New York.

33. Inequality myths

- **Myth 1:** Inequality is a necessary counterpart of economic dynamism and competitiveness. According to this myth, rising inequality is an inevitable consequence of rapid economic growth (or a necessary condition for competitiveness). Policies that lower inequality, it is claimed, reduce the incentives to work hard and innovate.
- **Myth 2:** The best way to help the poor is to help the rich ("Equity needs growth").
- **Myth 3:** Inequality is actually not a problem as long as extreme poverty is avoided and incomes are all rising ("the rising tide lifts all boats").
- **Myth 4:** As pay is related to ability, rising inequality is just the result of increasing differences in people's ability (I am paid more because I am worth it).

Vadaketh, Sudhir Thomas; Donald Low (2014): *Challenging the Singapore Consensus*.

34. The rich and the rest

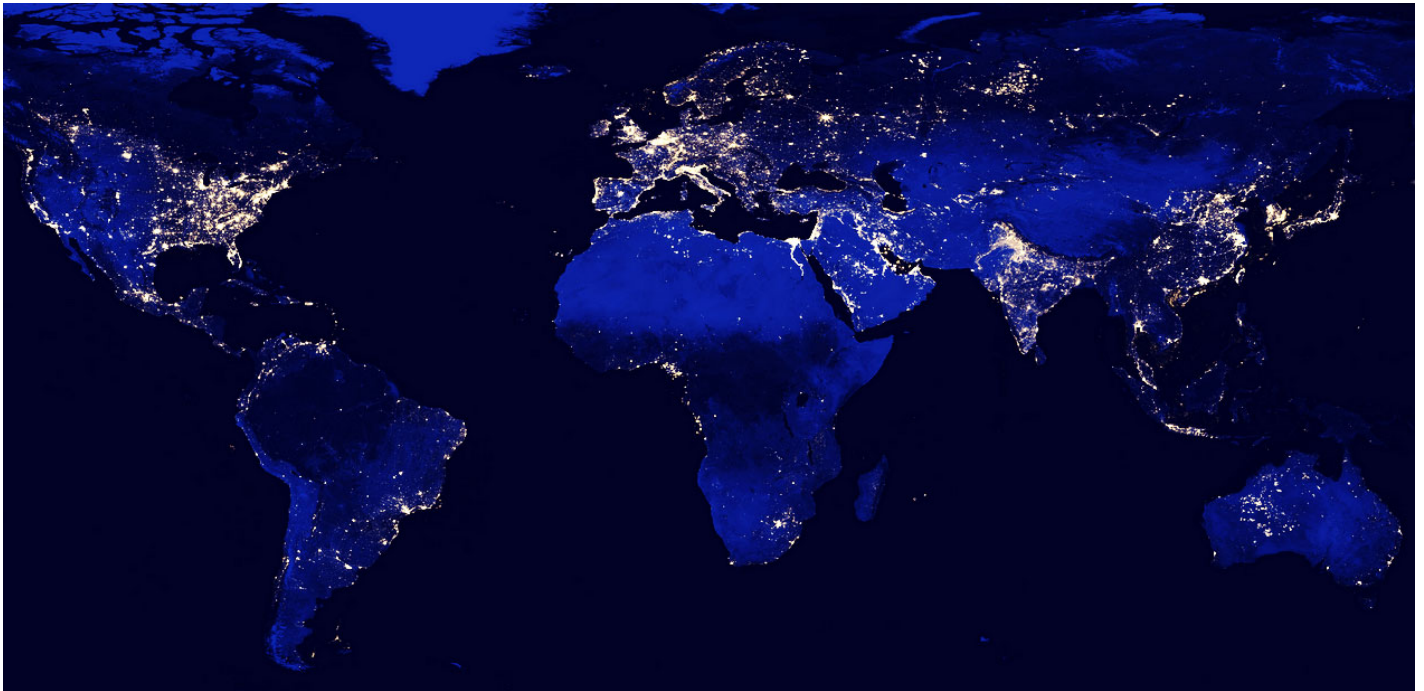
“Money flows across frontiers, but laws do not. The rich live globally, the rest of us have borders.”

“If you are a Syrian refugee, global visa restrictions severely limit your ability to travel. If you are a wealthy Syrian citizen, however, you can buy a passport from St Kitts and Nevis, Cyprus or half a dozen other countries, and suddenly you have access to a world of visa-free travel denied to your compatriots. If you are an ordinary Ukrainian, you are at the mercy of your country’s corrupt and inefficient court system. If you are a wealthy Ukrainian, however, you can arrange all of your business dealings so they are governed by English law, and enjoy the services of honest and effective judges. If you are an ordinary Nigerian, you must suffer what the country’s newspapers might say about you. If you are rich, however, you can hire London lawyers, and sue your country’s journalists based on the fact their online articles have been read in the UK and are subject to England’s famously tough libel laws. Most importantly, if you can structure your assets so they are held in the United States, your government will never find out about them (...), whereas they will find out about everything owned at home.”

Bullough, Oliver (2018): *Moneyland. Why thieves and crooks now rule the world*, Profile Books, London.

35. The Earth at night

Take any composite image showing simultaneously all the continents at night. Light appears to be a good estimate of wealth and prosperity: the illuminated areas tend to be the richest areas. Illustration: just compare North and South Korea.



https://upload.wikimedia.org/wikipedia/commons/b/ba/The_earth_at_night.jpg

**“The surest way to do more to help the [world’s] poor is to continue to open markets.”
Mike Moore, former Director General of the WTO**

36. Arguments for poverty reduction

“Studying global poverty, it is possibly unavoidable and probably essential to consider global justice. Any sincere effort to think about how to reduce poverty requires an ethical framework (...) Some writers argue from the assistance ethic: in effect, people around the world who are suffering from poverty are part of our human family and as such, we should do for them what we would do for a family member who is suffering. Other writers emphasize the restitution ethic. The former colonial powers and the leading countries of the global north have benefited so much from the global south – through cheap primary commodities, cheap labour and cheap products – that they have structured the international system to preserve their own advantages, which actually

creates poverty. There is also the legal and moral framework of human rights treaties which commit our governments (and urge us as individuals) to prevent violations to those rights posed by poverty and suffering. Finally, the self-interest argument holds that if you live comfortably in a high-income country, and you want to continue to enjoy that life, then you must work to reduce global poverty. Otherwise, conflict, terrorism, disease outbreaks, and mass migrations from poorer countries will put your lifestyle at risk.”

“These are all big, broad arguments for why we should work to reduce poverty, but they actually give us relatively little ethical guidance for how to reduce it. For that guidance, we must rely on the principles of solidarity, non-elite participation and decent sufficiency for all. These principles underlie ethically responsible development, which in turn must be based on standards of equity, empowerment, cultural freedom, environmental sustainability and human wellbeing (...) Well-intentioned but naïve meddling in people’s lives, helping people to eat for one day while failing to address long-term structural causes of poverty, really can do more harm than good. Nonetheless, we prefer to err on the side of action rather than inaction. All human lives are equal, and the ethos of humanist egalitarianism demands that we try to prevent avoidable suffering. Where human rights are being violated, where people are being denied basic capabilities to lead lives that they value, then we have a responsibility to act (...) Ultimately, we can all be part of a solution to global poverty, and if we are good global citizens, we all have an obligation to do so.”

Cosgrove, Serena; Benjamin Curtis (2017): *Understanding global poverty. Causes, capabilities and human development*, Routledge.

37. Workers vs (businesses & government): new state of exploitation?

“Since the beginning of the twenty-first century, we have been living in a state of drastic social transition; indeed, it is surprising that nobody forecast such extreme changes. Especially in Japan, the increase in the gap between the rich and poor has become quite large (...) The power of big business is quite formidable, and the status of workers is in a very fluid state.

Indeed, it seems that so-called disposable workers are no longer “human beings.” Younger generations are completely exhausted by the new state of exploitation (...) and have little hope for the future. They can be easily replaced by foreign unskilled workers. They are excluded from labor union protections that are typically in place solely for regular workers. And they are looking in vain for rosy opportunities just to become regular workers (...)

Foreign workers employed as technical interns also find themselves in terrible situations: they are being exploited with wage rates that are much lower than legal minimum standards. They must work long hours as unskilled workers and cannot acquire any new promised occupational skills. Disappointed from such unfair treatment, they quit their jobs, but then find (at least in Japan) that they have no public status or employment insurance. Some of them turn to crime (...)

On the other hand, big business is warmly supported by the government on the pretext of national profits and the maintenance of global competitive power. Why on earth is it that for 15 years we, the common people, have had to struggle for only small and ordinary levels of happiness?”

Kondoh, Kenji (2017): *The economics of international immigration. Environment, unemployment, the wage gap, and economic welfare*, Springer, Singapore.

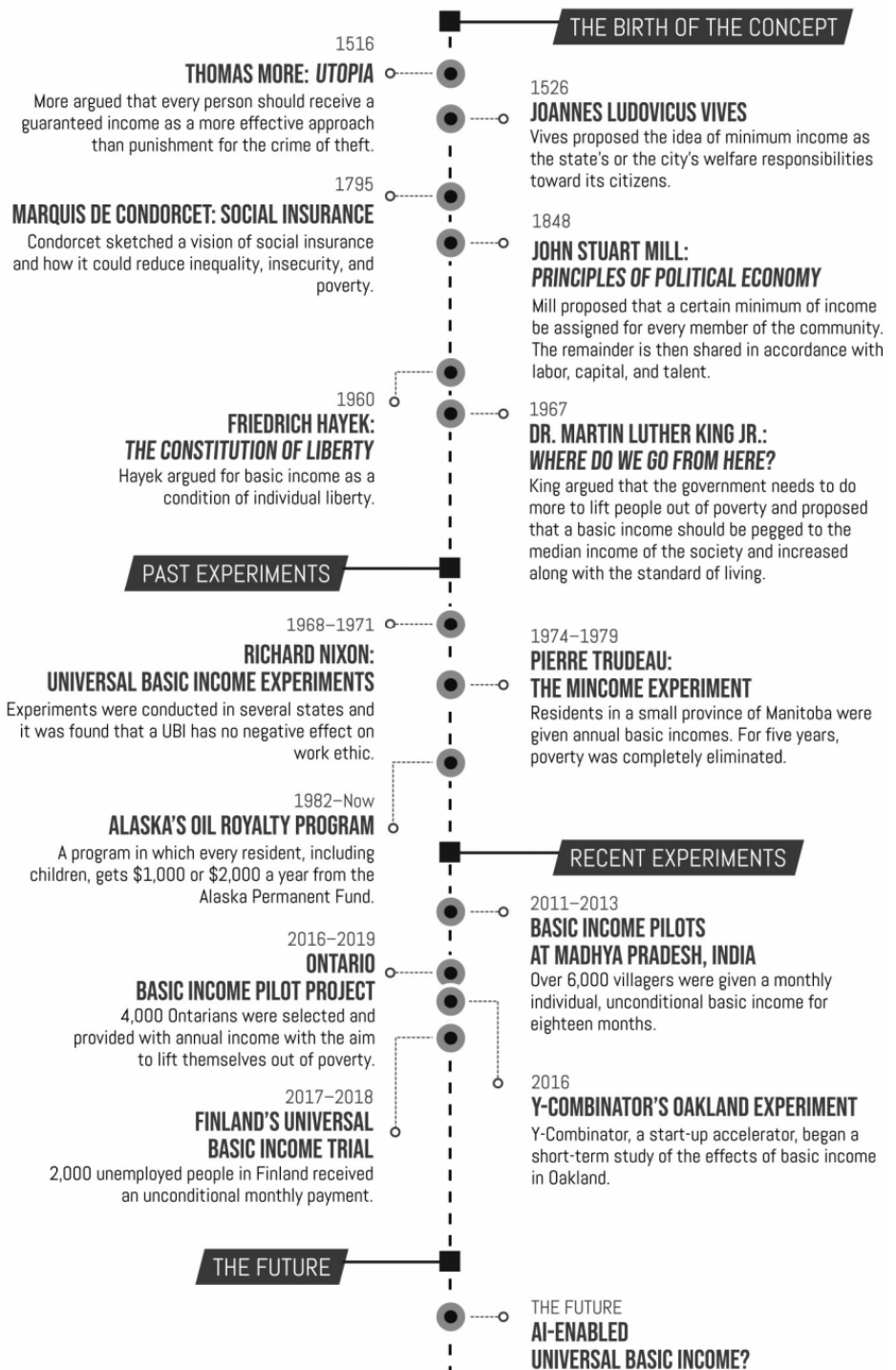
Powell, Benjamin; ed. (2015): *The Economics of immigration. Market-based approaches, social science, and public policy*, Oxford University Press, New York.

38. Universal Basic Income and Universal Basic Dividend

“... Universal Basic Income (UBI). This concept is already being tested in various forms in Denmark, Finland, Kenya, Canada, and even in a limited fashion in Stockton, California. The Indian state of Sikkim has plans to introduce India’s first and the world’s largest UBI experiment to date in 2022. In the Age of Automation, where we know many jobs will be lost to AI, the UBI uncouples income from work and will help to level the playing field for the disadvantaged. Increasing automation and decreasing employment create a need for as well as a pathway to a UBI that can provide opportunities in a more egalitarian way, freeing mental bandwidth from the stress of financial insecurity and sparking reserves of imagination and entrepreneurial spirit in the process. With a UBI, we may have a way to eliminate the need for food stamps, welfare, and other existing social programs, virtually eradicating poverty while adding trillions of dollars to the GDP.”

“Economist and former Greek Minister of Finance Yanis Varoufakis has suggested a variation on the UBI called Universal Basic Dividend (UBD), which would be financed as a percentage of all companies’ profits, affording citizens a right to a portion of the returns on all capital, particularly from profits made by technology companies that receive public funding.”

A BRIEF HISTORY OF UNIVERSAL BASIC INCOME



39. Wealth and inequality

“Today we in the West are richer than we have ever been, but more unequal. In some places – the USA and the UK – inequalities are particularly pronounced. The old social democratic dream of narrowing inequalities has been almost abandoned along with social democracy.”

“Today the great wealth accumulated by business elites causes envy and scandal, but the remedies proposed (tax them, control them, shame them) do not question the validity of capitalism, only one of its unpalatable outcomes.”

“The victory of market capitalism was sealed by the democratization of consumption.”

Sassoon, Donald (2019): The anxious triumph. A global history of capitalism, 1860-1914, Penguin.

40. The Four Horsemen of Leveling

“In recent decades, income and wealth have become more unevenly distributed in Europe and North America, in the former Soviet bloc, and in China, India, and elsewhere. And to the one who has, more will be given: in the United States, the best-earning 1 percent of the top 1 percent (...) raised their share to almost six times what it had been in the 1970s even as the top tenth of that group (the top 0.1 percent) quadrupled it (...) For thousands of years, civilization did not lend itself to peaceful equalization. Across a wide range of societies and different levels of development, stability favored economic inequality (...) Violent shocks were of paramount importance in disrupting the established order, in compressing the distribution of income and wealth, in narrowing the gap between rich and poor. Throughout recorded history, the most powerful leveling invariably resulted from the most powerful shocks. Four different kinds of violent ruptures have flattened inequality: mass mobilization warfare, transformative revolution, state failure, and lethal pandemics. I call these the Four Horsemen of Leveling.”

“For war to level disparities in income and wealth, it needed to penetrate society as a whole, to mobilize people and resources on a scale that was often only feasible in modern nation-states. This explains why the two world wars were among the greatest levelers in history (...) The shocks of the world wars led to what is known as the ‘Great Compression,’ massive attenuation of inequalities in income and wealth across developed countries.”

“Violent societal restructuring needs to be exceptionally intense if it is to reconfigure access to material resources. Similarly to equalizing mass mobilization warfare, this was primarily a phenomenon of the twentieth century. Communists who expropriated, redistributed, and then often collectivized leveled inequality on a dramatic scale. The most transformative of these revolutions were accompanied by extraordinary violence.”

“State failure takes the principle of leveling by violent means to its logical extremes: instead of achieving redistribution and rebalancing by reforming and restructuring existing polities, it wipes the slate clean in a more comprehensive manner.”

“In the past, plague, smallpox, and measles ravaged whole continents more forcefully than even the largest armies or most fervent revolutionaries could hope to do. In agrarian societies, the loss of a sizeable share of the population to microbes (...) made labor scarce (...) As a result, workers gained and landlords and employers lost as real wages rose and rents fell. Institutions mediated the scale of these shifts: elites commonly attempted to preserve existing arrangements through fiat and force but often failed to hold equalizing market forces in check. Pandemics complete the quartet of horsemen of violent leveling.”

“Other factors have a mixed record. From antiquity to the present, land reform has tended to reduce inequality most when associated with violence or the threat of violence—and least when not. Macroeconomic crises have only short-lived effects on the distribution of income and wealth. Democracy does not of itself mitigate inequality. Although the interplay of education and technological change undoubtedly influences dispersion of incomes, returns on education and skills have historically proven highly sensitive to violent shocks. Finally, there is no compelling empirical evidence to support the view that modern economic development, as such, narrows inequalities. There is no repertoire of benign means of compression that has ever achieved results that are even remotely comparable to those produced by the Four Horsemen (...) Even in the most progressive advanced economies, redistribution and education are already unable fully to absorb the pressure of widening income inequality before taxes and transfers.”

Scheidel, Walter (2017): *The great leveler. Violence and the history of inequality from the Stone Age to the twenty-first century*, Princeton University Press, Princeton and Oxford.

41. Inequality in the future

“It is an open question how well these high-equilibrium welfare systems will withstand two growing demographic challenges. The aging of European populations is one of them (...) Piketty’s argument that ongoing accumulation capital will raise both its share in national income and its overall importance relative to national income as rates of return on capital investment exceed economic growth, thereby putting upward pressure on inequality, has attracted a fair amount of criticism and caused its main proponent to stress the uncertainties associated with these predictions. Yet there is no shortage of other economic and technological forces capable of exacerbating existing disparities in the distribution of income and wealth. Globalization, which has been credited with disequalizing effects, especially in developed countries, shows no sign of abating in the near future. Whether this process will create some kind of global super-elite unfettered by the constraints of national policies (...)

remains to be seen. By their very nature, automation and computerization are more open-ended processes that are bound to influence the distribution of returns to labor (...) Our remaking of the human body will open up new frontiers in the evolution of inequality. The creation of cybernetic organisms and genetic engineering have the potential of expanding disparities among individual persons and even their descendants (...) Education has long been the default response to technological change (...) Would education ever be capable of counteracting entirely new degrees of artificial physical and mental enhancement?"

Scheidel, Walter (2017): *The great leveler. Violence and the history of inequality from the Stone Age to the twenty-first century*, Princeton University Press, Princeton and Oxford.

II. Ecological impact of global integration

42. The shifting baseline syndrome

“That’s what scientists call ‘Shifting Baseline Syndrome.’ Each generation accepts their version of nature, plunders it, then leaves the next generation to accept the depleted version and so on.”

Madam President S3 E16



43. Three concepts in Earth system science

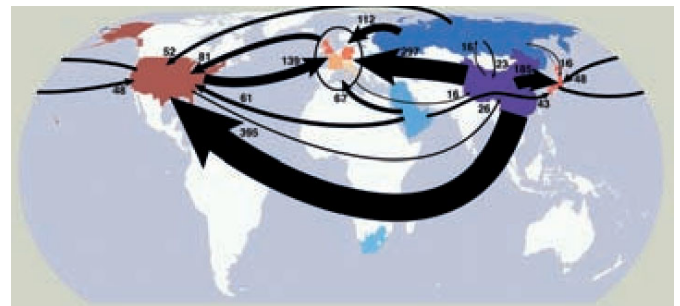
“Earth system science arose in the 1990s and early 2000s as the planet began to be understood as a complex, evolving, unified system that was more than the sum of its parts. Crucial to the emergence of this new way of thinking was a dawning awareness about two fundamental elements of the way integrated Earth system functions support life. The first was that the Earth itself is a single system, within which the biosphere is an active and critical component. In other words, the presence of life itself on Earth is critical to the creation of the conditions that make this life possible. More than that, the system itself is created and sustained by biodiversity: the sum total of all the immensely variegated life on the planet. The second key realization was that human activities are now so pervasive and profound in their consequences that they affect Earth system function at a global scale ‘in complex, interactive and accelerating ways.’”

- **Anthropocene:** humanity has become a geological force that influences how the Earth system functions.
- **Great acceleration:** the massive impact of human activity on the Earth system after World War II.
- **Planetary boundaries:** limits within which planetary conditions remain sufficiently stable for humanity to live and operate safely, in the present and the foreseeable future.

Sandford, Robert William; Jon O’Riordan (2017): *The hard work of hope. Climate change in the age of Trump*, RMB, Canada.

44. International flows of emissions embodied in trade

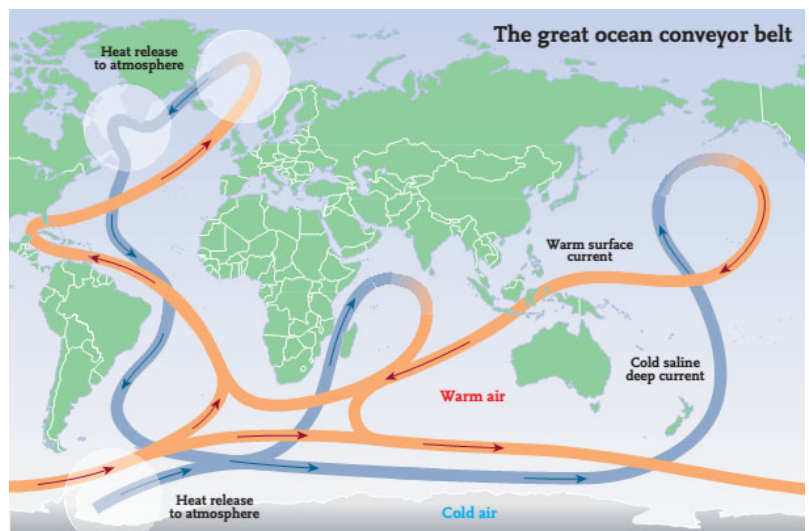
“... there’s an important side effect of globalization to be considered: the shift it produces in the balance of greenhouse emissions. When a country imports consumer goods, should the emissions produced by the manufacture of those goods be assigned to the destination country rather than the supplier? If they were, the United States would leap back into its longtime role as the world’s leading greenhouse emitter, because so many of its household products are made in other countries, particularly China. In recent years, as much as half of the increase in China’s greenhouse emissions has arisen from the manufacture of exports.”



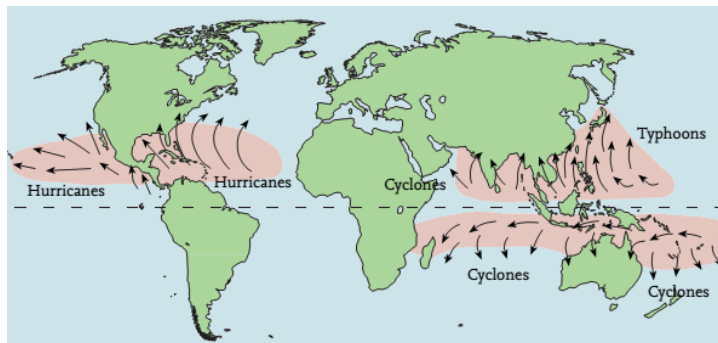
Henson, Robert (2011): *The rough guide to climate change. The symptoms, the science, the solutions*, Rough Guides, London.

45. Is the planet paying for globalization?

Some evidence appears to link human activity with the following phenomena (symptoms of climate change): extreme heat and heat waves; floods and droughts; deforestation and shrinking forests; the big melt (destruction of the permafrost –land frozen for at least two year–, the Greenland melt, erosion of glaciers, ice melting in the poles); rising sea level; changes in the global loop of



ocean circulation (the great ocean conveyor belt); oceans ‘increasingly stressed’; more ocean victims of climate change (coral reefs); more, and more intense, tropical cyclones (hurricanes, cyclones, typhoons); threats to biodiversity (flora, fauna) and farming.



Henson, Robert (2011): *The rough guide to climate change. The symptoms, the science, the solutions*, Rough Guides, London.

46. Climate change and farming (Robert Henson, 2011)

“**Winners and losers in farming.** A battle royal is setting up for the coming decades across the world’s farmlands, where the benefits of extra CO₂ and longer growing seasons will fight it out with intensified drought, spikes of extreme heat and other negatives. It looks as if the balance will have shifted toward the negative by the time mid-latitude land temperatures exceed pre-industrial values by around 3°C (5.4°F), which corresponds roughly to a global rise of around 2°C (3.6°F). One reason is that the fertilization effect of CO₂ for crops like wheat and rice tends to decrease once CO₂ is boosted beyond a certain point. Another is that most of the world’s food crops are grown in the tropics (...) One major study commissioned by the United Nations for 2002’s World Summit on Sustainable Development compared the relative winners and losers in agriculture for a mid-range scenario of global emissions increase by the 2080s. Among the findings:

- Losses in the tropics. Between 42 and 73 countries, many of them in Africa and Asia, could experience declines of at least 5% in their potential to grow cereal crops. Between one and three billion people would be living in countries that could lose 10–20% of their cereal crop potential.
- Gains in the north. In contrast, most of the world’s developed countries would experience an increase in cereal productivity of 3–10%.
- Agricultural GDP. In terms of agricultural gross domestic product, the biggest winners are likely to be North America (a 3–13% increase) and the former Soviet Union (up by 23%). By contrast, Africa could lose 2–9% of its agricultural GDP.”

47. Hydro-climatic change and world stability (Sandford and O’Riordan, 2017)

“Changes in the composition of the Earth’s atmosphere are causing water to move more energetically through the global hydrological cycle, making the world’s water crises even more urgent to address. Until we lost the relative stability of the planetary water cycle, we had no idea how much we relied on that stability. Water is at the very centre of human existence (...) What we are discovering is the extent to which the fundamental function of our political structures and global economy are predicated on relative hydrologic predictability, especially as it relates to precipitation patterns that define water security. As a result of the loss of relative hydrologic stability, it is not just food production, energy use and biodiversity-based Earth system function that are disrupted. Political and economic stability is also at risk in a number of regions in the world (...) Hydro-climatic change has the potential to literally and fundamentally redraw the map of the world (...) The concern among climate scientists is that in the absence of Arctic sea ice, and with oceans warming, we appear to be approaching the point where we have warmed the planet enough that the Earth itself and its cold oceans have begun to literally sweat out greenhouse gases (...) The problem is that there are a lot of hydrocarbons in the ground in the Arctic, and most are kept trapped there by an imperfect cap of frozen ground and permafrost (...) What we appear to be facing in the Arctic is a carbon-release time bomb.”

Sandford, Robert William; Jon O’Riordan (2017): *The hard work of hope: Climate change in the age of Trump*, RMB, Canada.

48. Western civilization = cancer for the Earth.

“Our civilization thus operates in the same way as a cancerous cell that goes on destroying the organism off which it lives.” (p. 3)

de Rivero, Oswaldo (2010): *The myth of development. Non-viable economies and the crisis of civilization*, Zed Books, London and New York.

49. Has humanity been changing the climate since the onset of agriculture? (Even before civilization started the war with nature?)

An anomalous rise in the methane trend coincided with the beginning of irrigation for rice in Southeast Asia. Natural processes fail to explain why new ice sheets have not reappeared in northeast Canada when the cycles of Earth's orbit predict that they should have. Thus, had humans not begun agriculture, there would now be a gigantic, continental ice sheet covering regions of Canada (W. F. Ruddiman, 2010, *Plows, plagues and petroleum: How humans took control of climate*).

50. Is capitalism eventually self-destructive?

The industrial capitalist society has created a chasm between society and nature, when the former cannot subsist independently of the latter. By destroying nature, the capitalist society destroys itself. The expansionary trends of a global capitalist economy places burdens on the planet and endangers its regenerative capacity.

51. Anthropocene

Term coined by atmospheric chemist Paul Crutzen that refers to the geological epoch in which humanity is capable of causing short-term changes in the planet. Fronts on which the planet is being assaulted by human activities: climate, ocean acidification, stratospheric ozone depletion, the nitrogen and the phosphorus cycles, global freshwater use, land use, biodiversity loss, chemical pollution. The term captures the idea that biogeochemical cycles, the atmosphere, the ocean, and the earth system as a whole are no longer immune to the human economy. It is preceded by the Holocene (the period started 10k-12k years ago).

52. The global ecological rift

It is the break in the relationship between the world economy and the planet arising from a continuously expanding world economy. There are insurmountable physical boundaries to economic expansion beyond which the planet's ecological viability is compromised. Are there thresholds (tipping points) for those fronts from which no return is possible? Has any of those thresholds been already crossed?

53. Social vs natural scientists

Social scientists do not appear to have risen to the challenge: even if the global problem is acknowledged, no real attack has been proposed or deemed necessary. "Sustainable (green) capitalism" is claimed to provide the solution. The real objective seems to be preserving capitalism rather than preserving the planet. "Saving" the planet is a new opportunity to make profits. A new capitalism can coexist with the planet. It is natural scientists who appear to be more concerned about the burdens industrial capitalism imposes on the planet.

54. Climate change: economic or political problem?

"I differ with those who identify capitalism as the principal fault line on the landscape of climate change. It seems to me that this landscape is riven by two interconnected but equally important rifts, each of which follows a trajectory of its own: capitalism and empire (the latter being understood as an aspiration to dominance on the part of some of the most important structures of the world's most powerful states). In short, even if capitalism were to be magically transformed tomorrow, the imperatives of political and military dominance would remain a significant obstacle to progress on mitigatory action."

"The fact is that we live in a world that has been profoundly shaped by empire and its disparities. Differentials of power between and within nations are probably greater today than they have ever been. These differentials are, in turn, closely related to carbon emissions. The distribution of power in the world therefore lies at the core of the climate crisis."

55. Climate change: who is to bear the adjustment costs?

“The cynicism of the politics of the armed lifeboat is matched, on the other side, by the strategy that the elites of some large developing countries, like India, seem to be tacitly inclining towards: a politics of attrition. The assumption underlying this is that the populations of poor nations, because they are accustomed to hardship, possess the capacity to absorb, even if at great cost, certain shocks and stresses that might cripple rich nations (...) In poor countries, even the middle classes are accustomed to coping with shortages and discomforts of all sorts; in the West, wealth, and habits based upon efficient infrastructures, may have narrowed the threshold of bearable pain to a point where climatic impacts could quickly lead to systemic stress.”

“The geologist David Archer reckons that to reach a genuinely fair solution to the problem of emissions would ‘require cuts in the developed world of about 80 percent. For the United States, Canada and Australia, the cuts would be closer to 90 percent.’”

56. Politics of climate change

“One of the most important factors in the global politics of climate change is the role the Anglosphere plays in today’s world (...) The fact that laissez-faire ideas are still dominant within the Anglosphere is therefore itself central to the climate crisis. In that global warming poses a powerful challenge to the idea that the free pursuit of individual interests always leads to the general good, it also challenges a set of beliefs that underlies a deeply rooted cultural identity, one that has enjoyed unparalleled success over the last two centuries. Much of the resistance to climate science comes exactly from this, which is probably why the rates of climate change denial tend to be unusually high throughout the Anglosphere. Yet it is also true that the Anglosphere, the United States in particular, has produced the overwhelming bulk of climate science, as well as some of the earliest warnings of global warming.”

57. 2015 texts on climate change

“2015 did produce two very important publications on climate change: the first, Pope Francis’s encyclical letter *Laudato Si’*, was published in May; while the second, the Paris Agreement on climate change, appeared in December (...) In *Laudato Si’*, the words *poverty* and *justice* keep close company with each other. Here poverty is not envisaged as a state that can be managed or ameliorated in isolation from other factors; nor are ecological issues seen as problems that can be solved without taking social inequities into account (...) This in turn leads to the blunt assertion that ‘a true “ecological debt” exists, particularly between the global north and south’. Here again the contrast with the Paris Agreement is stark. When poverty finds mention in the Agreement, it is always as a state in itself, to be alleviated through financial and other mechanisms. The word never occurs in connection with *justice*.”

“In the text of the Paris Agreement, by contrast, there is not the slightest acknowledgement that something has gone wrong with our dominant paradigms; it contains no clause or article that could be interpreted as a critique of the practices that are known to have created the situation that the Agreement seeks to address. The current paradigm of perpetual growth is enshrined at the core of the text.”

Ghosh, Amitav (2016): *The great derangement. Climate change and the unthinkable*, Allen Lane.

58. Big threats to 21st century world economy.

Threat of scarcity and threat of abundance: ecological catastrophe (how it affects the future of life on Earth) and automation (how it affects the future of work in economies).

59. Magnification

Globalization multiplies the human impact on the planet. Many consequences of this impact will remain even if globalization stops or reverts. At present, drinkable water sources are being depleted, soils eroded, glaciers melting, sea ice diminishing, fish stocks disappearing, extreme storm events increasing in frequency, human population growing...

60. Are we too many?

Currently at some 7.3 billion, population grows by about 80 million per year. Around one billion suffer from hunger. The population explosion in the world after World War II was facilitated by the diffusion of medical care to underdeveloped countries (thanks to institutions like the World Health Organization and UNICEF). The demographic dividend (more young than old people allowing the economy a financial surplus) will eventually fade away and the situation reverse when the boomers retire (will there be enough people to play for the pensions? How will an aging population be supported?).

61. Increasing CO₂ concentration in the atmosphere

The burning of fossil fuels and cutting down of forest have emitted, since the start of the industrial revolution, more than 0.5 trillion tons of CO₂. This has created the highest concentration of CO₂ in the last 800,000 years. In 2013, global concentration of atmospheric carbon dioxide reached 400 parts per million, a threshold unsurpassed in the last 3 million years.

62. Ocean acidification

Since the seas and the atmosphere exchange gases, part of the atmospheric CO₂ ends up in the oceans, thereby contributing to its acidification. Ocean acidification has been called *global warming's equally evil twin* (Jane Lubchenco), as it changes the chemistry of seawater.

63. Limits to growth (Meadows et al., 2005)

- **Increasing cost of sustaining growth.** An expanding population combined with an increasing accumulation of physical capital requires more resources to be diverted to cope with global ecological constraints (depletable natural resources and limited absorption capacity of emissions). This will eventually restrain the capacity of expanding production and the sustainability of economic growth.
- **Scenarios.** The inability to continuously sustain an expansion of production will cause a population contraction. (1) The end of growth takes the form of a collapse (rapid decline in output, population, health and an increase in conflict, inequality, ecological devastation following a growth overshoot). (2) It may take the form of a smooth adaptation to the Earth's support capacity (through some corrective action).
- **The big question.** Has humanity already overshoot the Earth's carrying capacity (surpassed the global ecological constraints?).
- **Evidence of soft landing or apparent success in attaining sustainable growth?** During the last decades: new technologies to lower pollution have been developed, consumers have adapted habits, international agreements have been signed, new institutions have emerged, higher income levels have reduced population growth, more widespread awareness of environmental problems... humanity already overshoot the Earth's carrying capacity.
- **The global challenge.** A sustainable world economy demands that the poorer countries reach higher consumption levels. This transition will have to be accompanied with technological, social and political changes consistent with long run goals. Those changes will need decades, but meanwhile the ecological footprints of humanity become bigger.
- **Three outlooks.** (1) Optimism: with adequate information, people will choose the right solution (global solutions to avert overshoot or, at least, collapse). (2) Cynicism: people will not stop responding to just short term goals and will not sacrifice current welfare levels to benefit future generations (reality will be ignored). (3) Middle road: lessons will be learned the hard way (a sustainable path will be reached, and collapse averted, only after having suffered global crises resulting from inaction or insufficient responses, but at the price of exhausting resources, losing attractive options, suffering more inequality and tolerating more conflict).

Meadows, Donella; Jorgen Randers; Dennis Meadows (2005): *Limits to growth. The 30-year update*, Earthscan, London.

64. Coase theorem (Ronald Coase)

“Let exclusive property titles to the environment be defined, and let them be transferable. Let there be no transaction costs. Let individuals maximize their utilities, and let them be non-altruistic. Then a bargaining solution among different users of the environment will result in a Pareto-optimal allocation of the environment. The resulting allocation is independent of the initial distribution of property titles.”

Siebert, H. (2008): *Economics of the environment*, Springer, Berlin.

Wiesmeth, Hans (2012): *Environmental economics Theory and policy in equilibrium*, Springer, Berlin.

“The negotiations are currently still in a deadlock because short-term national interests are blocking a prompt and effective global climate protection agreement...”

German Advisory Council on Global Change (WBGU) (2009): *Solving the climate dilemma. The budget approach*, Berlin.

“...the reasons for Americans' failure to recognize the great significance of climate change is that we are wedded to an economic model and practices that privilege competition over cooperation, selfish pursuits over promoting the common good, and greed over generosity. Ingrained in American society and practices are emphases on “big,” “fast,” “efficient,” “competitive,” and “profitable.” We Americans have not especially privileged “sustainable” in our communities, society, and economy.”

Judith Blau (2017): *The Paris Agreement. Climate change, solidarity, and human rights*, Palgrave Macmillan, Cham, Switzerland.

“... Pericles wisely observed that ‘where there is no vision, the people shall perish.’ Today, a lack of vision with respect to climate change adaption and mitigation will lead to populations and nations that indeed perish from flooding, drought, health crises and environmental destruction. The signs are clear and undeniable in all parts of the world where weather phenomena triggered by climate change are becoming increasingly evident and dangerous. Climate projections for the year 2100 are daunting...”

Ross Michael Pink (2018): *The climate change crisis. Solutions and adaption for a planet in peril*, Palgrave Macmillan, Cham, Switzerland.

65. History is an opportunity to learn from past mistakes

“The greatest risk to humanity in coming decades is the risk that we may continue to damage our environment to a degree incompatible with our current standard of living, or even incompatible with our existence.” All pre-industrial societies were vulnerable to collapse: a local intense decrease in human population and/or in political, economic, or social complexity.

- Easter Island is a spectacular historical example of collapse. When humans settled, the environment was rich; eventually, forest were completely cleared and most bird species become extinct. Other examples: Mangaia, Mangareva, Rapa, low Marquesan islands, parts of New Caledonia, parts of Fiji. In some islands in the Pacific the result was complete abandonment. Some Native American societies (like the Anasazi) in the U.S. Southwest before 1492 constitute another example of collapse.
- Despite the fact that societies apparently tend to approach the margin of what the environment can support, in the past collapse was not the necessary outcome: many societies have existed continuously for thousands of years without any signs of collapse (Japan, Java, Tonga, Tikopia, Tahiti, Rarotonga). Are modern (technological advanced societies) immune to collapse?
- Why, when environmental disaster seems apparent, measures are not always taken to avert disaster? How to differentiate environmental factors (deforestation, salinization, soil nutrient exhaustion, drop of water tables, drought) behind collapse from cultural/social factors?

Diamond, Jared (2000): *Ecological collapses of pre-industrial societies*, Tanner Lectures on Human Values.

66. Jared Diamond's (2000) explanation of collapse

“... people living in fragile environments, adopting solutions that were brilliantly successful and understandable in the short run, but that failed or else created fatal problems in the long run when confronted with external environmental changes or human-caused environmental changes that people without written histories or

archaeologists could not have anticipated.”“Past societies faced frequent ecological crises of small amplitude over small areas. Modern global society faces less frequent but bigger crises over larger areas.”

67. Are non-ambiguous the lessons of the past?

The response to the environmental crises in Western Europe between the 14th and 18th centuries was innovation and intensification. This response was flexible, broad, decentralized and protracted. Based on this experience, is alarmist the claim that, under the current pattern of global resource exploitation, the future of humanity is at risk? Butzer (2012) contends that one should not ignore the resilience and the capacity of readaptation of societies. Social stress creates the conditions and incentives to try new ideas and solutions, above all in societies favouring bottom-up options, in contrast to the authoritarian strategies characteristic of pre-industrial societies.

68. Intensification

According to Tainter (2006), the big question at present is whether intensification can continue indefinitely. The view of orthodox economists is that new technologies and new resources to address all kinds of problems will always be found: the future is always promising. The alternative view is that the present global civilization is like any other previous civilization, in the sense that no civilization can survive the destruction of its natural base. Economies depend on ecosystems. What is the future of an economy shrinking forests, eroding soils, depleting aquifers, collapsing fisheries, raising temperature, melting ice sheets...? Collapse in the past was typically preceded by the spread of hunger (hunger at the global scale has not yet disappeared).

69. Technology and complexity

Modern societies rely on a continued improvement of technology. This makes economies increasing complex and all its components more interdependent. As a result, economies are more vulnerable to shocks. The infrastructures required to maintain the stability and complexity of modern economies (electrical power, water and food supply, communication, transportation, health care, defense, finance) are increasingly intertwined, so that troubles in one component more easily may spread to other components.

70. The Malthusian law: humanity cannot defeat nature

Thomas Robert Malthus (1766–1834) put forward the thesis that population growth is (at least eventually) faster than agricultural growth (food production) and that, in fact, population tends to increase beyond the numbers that can be fed. This thesis questioned the sustainability of an increasing population. As a result of the different potential capacity of population and food supplies to expand, a continued population growth will be negatively checked by food shortages, poverty, deprivation and diseases. Hence, if population is not positively checked (measures that reduce fertility), its growth will come to an end through famine (insufficient food supply). Malthus did not see in technological progress an escape from this law: increases in population are always dangerous and stimulated by increasing prosperity, so technological improvements merely increase the size of population checked down by famine. A modern, environmental version of the Malthusian law is that population growth is, by necessity, limited by the natural environment.

71. The Malthusian view

By extension, a Malthusian view can be defined according to which population (population growth, specifically) is the source of all problems. A continued population growth will worsen existing problems and generate new ones. According to Robert May (1993), “the continuing growth of human populations (...) is the engine that drives everything.”

72. Kenneth Boulding's theorems on population

- **The Dismal Theorem.** If the only ultimate check on the growth of population is misery, then the population will grow until it is miserable enough to stop its growth.

- **The Utterly Dismal Theorem.** Technical improvements can only relieve misery temporarily: since, by The Dismal Theorem, misery will ultimately check population, the final result of any technical improvement is increase the amount of people that will live in misery and, accordingly, the total amount of human misery.
- **The Moderately Cheerful Form Dismal Theorem.** If misery and starvation is not the only way to keep a prosperous population in check, population does not have to grow until it is miserable and starves, so it can be stably prosperous.

73. Bartlett's Laws of Sustainability

- "Population growth and/or growth in the rates of consumption of resources cannot be sustained".
- "The larger the population of a society and/or the larger its rates of consumption of resources, the more difficult it will be to transform the society to a condition of sustainability". These two laws imply that the concept of sustainable growth is an oxymoron.

Bartlett, Albert A. (1998): "Malthus marginalized: The massive movement to marginalize the man's message", *The Social Contract*, 239-252

Boulding, Kenneth (1971): "Foreword to T. R. Malthus, *Population, The First Essay*", in *Collected Papers, Vol. II, Colorado Associated University Press, Boulder*, pp. 137-142.

Bartlett, A.A., (1994), "Reflections on sustainability, population growth, and the Environment", *Population & Environment* 16(1), pp. 5-35.

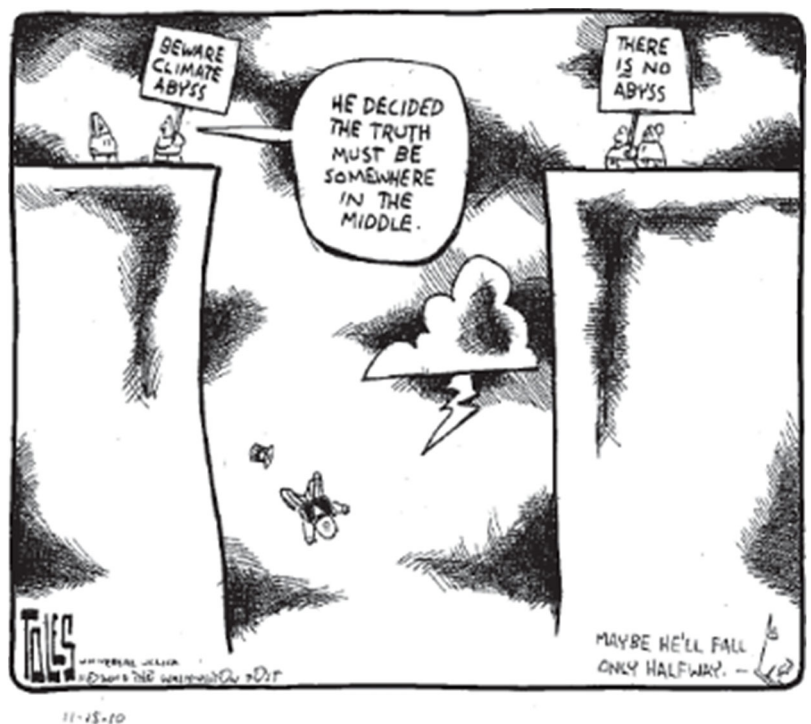
74. Global environmental threats: ozone depletion

The stratospheric ozone layer (acting like a sunscreen) absorbs the portion of the ultraviolet light (UV-B radiation) that is harmful to most life on Earth (UV-B radiation cause damage to eyes, skin, genetic material, the immune system...). Excessive UV-B exposure is likely to compound its effects on the ecosystem with other global environmental threats: global warming, ocean acidification and pollution. The 2008 Antarctic ozone hole was one of the largest and most long-lived. The biggest ozone hole over the Arctic occurred in 2011.

Abbasi, S. A.; Tasneem Abbasi (2017): *Ozone hole. Past, present, future*, Springer, New York.

75. The virtue is not always on the middle ground

On certain debates that rely on matters of fact and objective information (like climate change) supporting the view that there are two equal sides implicitly justifies bad-faith skepticism (skepticism that does not intend to improve understanding of reality and that simply claims that it is legitimate to doubt about everything). Regarding the issue of whether climate change is human-caused, the weight of the sides (publishing scientists) is something like 97% against 3%.

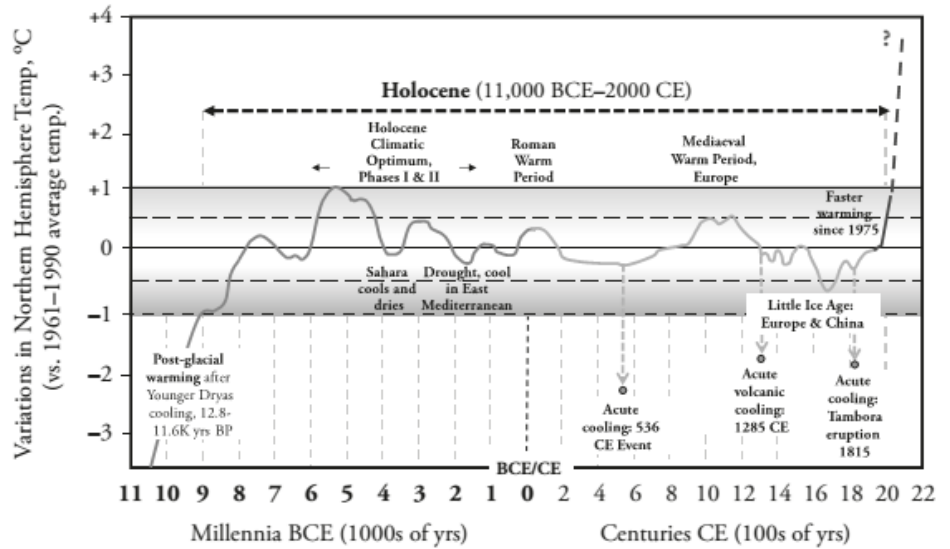


76. The hockey stick curve

The hockey stick curve is a graph depicting temperature trends in the last millennium. It shows the unprecedented nature of modern global warming. The scientific community has reached a general consensus that climate change is real (it is actually occurring), caused by the activity of human beings and already a problem.

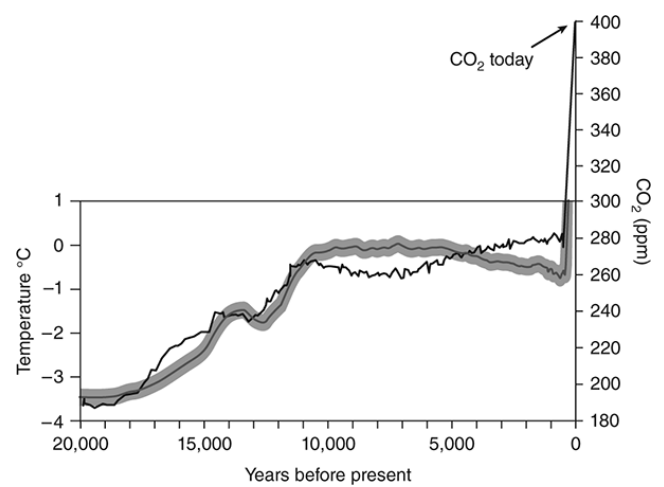
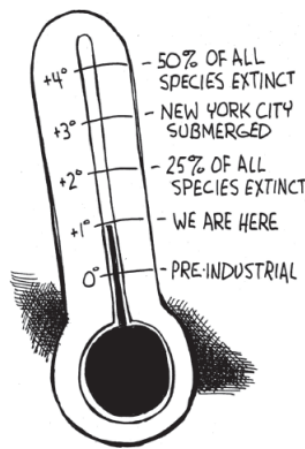
77. CO₂ emissions

Human activity generates more than 30 billion tons of CO₂ pollution per year. Averaging the weight of a human being at 70 kg, these 30 gigatons are equivalent to the weight of 428,5 billion people. So the annual weight of CO₂ emissions is some 60 times the total number of people on the Earth.



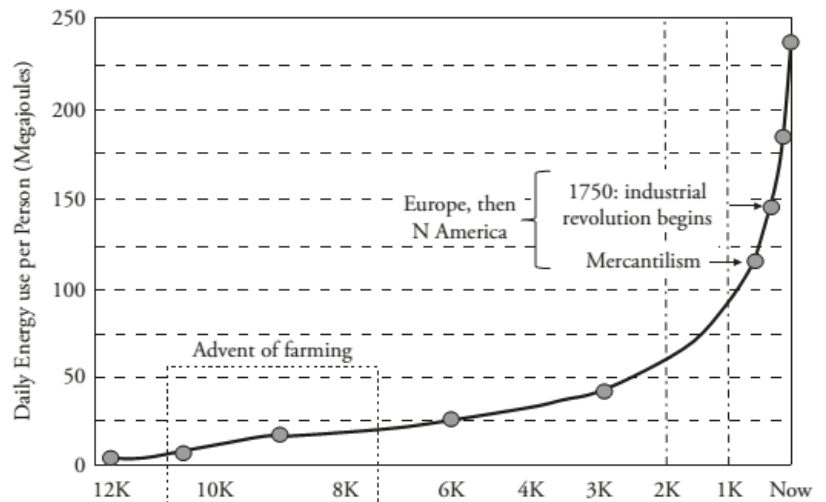
78. Ecological footprint

The ecological footprint is an estimate of the amount of resources, production, consumption and waste used by an individual. Its units are planet units: the number of planet Earths needed if every individual lived the way the individual lives. This footprint is growing. Total human demands exceeded Earth's biocapacity around 1980. Currently the demand requires the equivalent biocapacity of 1.5 Earths to feed, provide materials, regenerate, self-replenish and absorb wastes.



79. Energy use

At the onset of the agricultural revolution (some 10,000 years ago) farmers used 20 megajoules of energy (physical labor) daily. The average North American now operates daily on at least 1,000 megajoules. The current global average is around 250 megajoules.



80. Has humanity been climately fortunate?

During the Holocene, the last 12,000 years, the global climate has been relatively constant. Average global surface temperature: 15°C. Regional decadal- average temperatures rarely have exceeded 2°C. In Europe, temperatures between the peak Medieval Warm and the Little Ice Age nadir differed by some 1.5°C. So the trajectory of the world economy since the agricultural revolution has been blessed by a (extraordinary?) stable global climate. How much could this lucky conditions last? Now, humanity faces changes in the global climate greater and faster than anything in recorded human history. The world may be heading towards an average global warming of up to 4°C during the 21st century.

81. Message on Climate Change to World Leaders

“Human-induced climate change is an issue beyond politics. It transcends parties, nations, and even generations. For the first time in human history, the very health of the planet, and therefore the bases for future economic development, the end of poverty, and human wellbeing, are in the balance. If we were facing an imminent threat from beyond Earth, there is no doubt that humanity would immediately unite in common cause. The fact that the threat comes from within —indeed from ourselves— and that it develops over an extended period of time does not alter the urgency of cooperation and decisive action.” Signed by over 4,000 scientists worldwide, July-August 2014.

Mann, Michael E.; Tom Holes (2016): *The madhouse effect. How climate change denial is threatening our planet*, Columbia University Press, New York

Maslin, Mark (2014): *Climate change. A very short introduction*, Oxford University Press, Oxford, UK.

McMichael, Anthony J.; Alistair Woodward; Cameron Muir (2017): *Climate change and the health of nations. Famines, fevers, and the fate of populations*, Oxford University Press, New York.

National Academy of Sciences; The Royal Society (non-dated): *Climate change: Evidence and causes*.

Westergård, Rune (2018): *One planet is enough. Tackling climate change and environmental threats through technology*, Cham, Switzerland.

82. Gaia theory

It is the view that planet Earth is a self-regulating system consisting of the totality of living organisms, surface rocks, ocean and atmosphere theory. All these elements interact as an evolving system. The theory ascribes a goal to the system: the surface conditions on Earth are self-regulated to be favourable to preserve existing life. Earth system science developed from Gaia theory by retaining the view of Earth as a dynamic entity whose material and living parts are coupled and that self-regulates its climate and chemistry, but by rejecting the claim that self-regulation has the goal of habitability.

Lovelock, James (2000): *Gaia: A new look at life on Earth*, Oxford University Press, Oxford, UK.

Lovelock, James (2009): *The vanishing face of Gaia: A final warning*, Basic Books, New York.

Dawson, Jonathan; Ross Jackson; Helena Norberg-Hodge (2010): *Gaian economics. Living well within planetary limits*, Permanent Publications, Hampshire, UK.

83. The PAT formula: $I = PAT$

The environmental impact I of a society equals the product of population P (demographic causes/factors), affluence A (capital accumulation) and technology T (A and T summarize the socioeconomic cause). The component A can be expressed as $\frac{K}{L} \cdot \frac{Y}{K}$, where K represents the capital stock, L population and Y aggregate production (GDP). The ratio $\frac{K}{L}$ is a measure of the intensification of the economy (how much capital per person is available to produce) and the ratio $\frac{Y}{K}$ is the average productivity of the capital stock (how much production each unit of capital generates). The component T can be decomposed as $\frac{E}{Y} \cdot \frac{impact}{E}$, where E stands for “energy” (so E/Y is the amount of energy per unit of product) and $\frac{impact}{E}$ measures the environmental impact per unit of energy used in production.

84. Global energy dilemma

A stable economic development depends on enough energy resources being available. The dilemma is that the energy contest between renewables and non-renewables (fossil fuels) is weighted in favour of the infrastructures, strategies and interests of the oil majors. The transition probably requires new players but the existing players have an almost complete power to block entrance. The transition is relatively straightforward, as the new technologies exist and the annual cost of implementing it is moderate (less than 2% of GDP). The

obstacles preventing the transition are political: particular interests dominate at the national level, and national interests at the global level (Gwynne Dyer, 2008, *Climate wars*).

85. The catastrophic convergence (Christian Parenti, 2016)

“Climate change arrives in a world primed for crisis. And the political responses to climate change increasingly take the form of ethnic, religious, or class violence in the form of banditry, rebellion, warfare, state repression and general militarisation. This is because the current and impending dislocations of climate change intersect with the already existing crises of poverty and inequality left by thirty years of neoliberalism, and the violence and tattered social fabric left by Cold War-era military conflicts. I call this collision of political, economic and environmental disasters the ‘catastrophic convergence.’”

“Societies, like people, deal with new challenges in ways that are conditioned by the traumas of their past. Thus damaged societies, like damaged people, often respond to new crises in ways that are irrational, short-sighted and self-destructive. In the case of climate change, the past traumas that set the stage for bad adaptation – a destructive social response– are Cold War-era militarism and the economic pathologies of neoliberal capitalism. Over the last forty years, both these forces have distorted the state’s relationship to society – removing and undermining the state’s collectivist, regulatory and redistributive functions– while overdeveloping its repressive and military capacities. And this, I contend, seriously challenges society’s ability to avoid violent dislocations as climate change kicks in.”

“Societies suffering from continued neoliberal austerity measures, and a new round of counter-insurgency now delivered under the framework of the war on terror, cannot be expected to address the implications of climate change. Real mitigation likewise requires moving away from an unbridled free market economic orthodoxy that is only hindering our attempts to cope with climate change.”

Parenti, Christian (2015): “The catastrophic convergence: Militarism, neoliberalism and climate change,” chapter 1 in Buxton, Nick; Ben Hayes; eds. (2016): *The secure and the the dispossessed. How the military and corporations are shaping a climate-changed world*, Pluto Press, London.

86. Planetary boundaries

“The ecological ceiling comprises the nine planetary boundaries proposed by an international group of Earth-system scientists led by Johan Rockström and Will Steffen. These nine critical processes are:

- *Climate change.* When greenhouse gases such as carbon dioxide, methane and nitrous oxide are released into the air, they enter the atmosphere and amplify Earth’s natural greenhouse effect, trapping more heat within the atmosphere. This results in global warming, whose effects include rising temperatures, more frequent extremes of weather, and sea level rise.
- *Ocean acidification.* Around one quarter of the carbon dioxide emitted by human activity is eventually dissolved in the oceans, where it forms carbonic acid and decreases the pH of the surface water. This acidity reduces the availability of carbonate ions that are an essential building block used by many marine species for shell and skeleton formation. This missing ingredient makes it hard for organisms such as corals, shellfish and plankton to grow and survive, thus endangering the ocean ecosystem and its food chain.
- *Chemical pollution.* When toxic compounds, such as synthetic organic pollutants and heavy metals, are released into the biosphere they can persist for a very long time, with effects that may be irreversible. And when they accumulate in the tissue of living creatures, including birds and mammals, they reduce fertility and cause genetic damage, endangering ecosystems on land and in the oceans.
- *Nitrogen and phosphorus loading.* Reactive nitrogen and phosphorus are widely used in agricultural fertilisers but only a small proportion of what is applied is actually taken up by crops. Most of the excess runs off into rivers, lakes and oceans, where it causes algae blooms that turn the water green. These blooms can be toxic and they kill off other aquatic life by starving it of oxygen.

- **Freshwater withdrawals.** Water is essential for life and is widely used by agriculture, industry and households. Excessive withdrawals of water, however, can impair or even dry up lakes, rivers and aquifers, damaging ecosystems and altering the hydrological cycle and climate.
- **Land conversion.** Converting land for human use – such as turning forests and wetlands into cities, farmland and highways – depletes Earth’s carbon sinks, destroys rich wildlife habitats, and undermines the land’s role in continually cycling water, nitrogen and phosphorus.
- **Biodiversity loss.** A decline in the number and variety of living species damages the integrity of ecosystems and accelerates species extinction. In doing so it increases the risk of abrupt and irreversible changes to ecosystems, reducing their resilience and undermining their capacity to provide food, fuel and fibre, and to sustain life.
- **Air pollution.** Micro-particles, or aerosols, emitted into the air – such as smoke, dust and pollutant gases – can damage living organisms. Furthermore, they interact with water vapour in the air and so affect cloud formation. When emitted in large volumes these aerosols can significantly alter regional rainfall patterns, including shifting the timing and location of monsoon rains in tropical regions.
- **Ozone layer depletion.** Earth’s stratospheric ozone layer filters out ultraviolet radiation from the sun. Some human-made chemical substances, such as chlorofluorocarbons (CFCs) will, if released, enter the stratosphere and deplete the ozone layer, exposing Earth and its inhabitants to the sun’s harmful UV rays.”

Raworth, Kate (2017): *Doughnut economics. Seven ways to think like a 21st-century economist*, Random House Business Books.

87. The Environmental Kuznets Curve

“The argument is that as poor countries begin to develop, they grow fast, pollute wantonly, and worry about the impacts later, after they’ve gotten rich. Such a view has become conventional wisdom for nations such as China and India. By this reasoning, one gets the counterintuitive result that the solution to environmental problems is to grow faster.



The Environmental Kuznets Curve was originally measured for individual pollutants such as sulfur dioxide and nitrogen oxide, which have been regulated in wealthy nations. The evidence was statistical and economy-wide, and the actual mechanisms that drive the finding were not tested. One assumption was that richer economies shift to less polluting services. Another was that as citizens get wealthier, they pressure the government to crack down on polluters and clean up the air, water, and toxic wastes of industry.

As it turns out, the Environmental Kuznets Curve findings haven’t held up well, especially beyond the original cases of specific pollutants, and those results have also been questioned on technical grounds. The hypothesis is completely wrong for greenhouse gas emissions, which do not decline at any level of income. (Rich countries have been the biggest emitters.) Ecological footprint also grows with income, and even in wealthy countries, many ecosystems, such as fisheries, water systems, and soil systems, continue to decline. The Environmental Kuznets Curve, a more nuanced form of market-based eco-optimism, turns out to be an unreliable guide to sustainability.”

Schor, Juliet B. (2011): *True wealth. How and why millions of Americans are creating a time-rich, ecologically light, small-scale, high-satisfaction economy*, Penguin Books, New York.

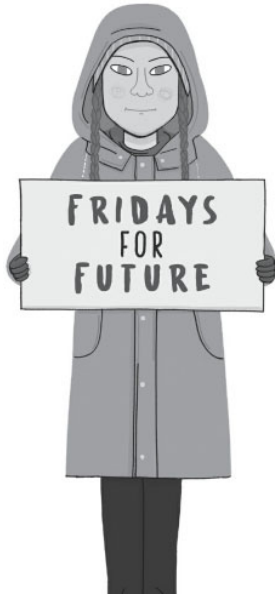
88. Greta Thunberg

“... in our daily life, every single one of us can commit to reducing our impact on the health of the planet by limiting waste and pollution as much as possible. But unfortunately, this is not enough. We need more than the good intentions of individual people. Faced with an issue as complex as this, you have to change the rules and make new laws to protect the environment. Who else

can do this if not the men and women sitting in the parliament? That’s why

Greta went there that morning. On that day – Monday the 20th of August 2018 – Greta launched her school strike.”

“The world’s leaders were behaving childishly. They ignored environmental problems because they were afraid of how complex they were. So the children, who were worried about their own futures, decided to protest to convince the politicians. And the school strike that Greta Thunberg had started, all by herself, outside the Swedish Parliament in August 2018 was only the first step. In just a few months, the number of cities where people, many of them schoolchildren, were protesting had reached 270. More than 20,000 students in every corner of the world had stopped going to school, following the example of the *skolstrejk för klimatet* (...) Time, the prestigious and iconic American weekly magazine, named Greta one of the most influential teens of 2018 (...) Thanks to her incredible achievements, Greta was nominated for the 2019 Nobel Peace Prize.”



Camerini, Valentina (2019): *Greta's story. The schoolgirl who went on strike to save the planet*, Simon & Schuster, London.

89. The imperial mode of living

“By [imperial mode of living] we aim to understand both the persistence and, at the same time, crisis-deepening patterns of production and consumption that are based on an– in principle– unlimited appropriation of the resources and labour capacity of both the global North and the global South and of a disproportionate claim to global sinks (like forests and oceans in the case of CO₂).”

“We argue that the increase of productivity and material prosperity in the capitalist centres depends on a world resource system and international division of labour that favours the global North and is rendered invisible through the imperial mode of living, so that the domination and power relations it implies are normalized. Since the beginning of industrial capitalism, the imperial mode of living gained certain stability and hegemony at the cost of environmental destruction and the exploitation of labour. Societal relations as well as societal nature relations were stabilized (...) due to its environmentally and socially unsustainable character.

(...) Due to the imperial mode of living and its global spread, societies seem to be approaching the limits to capitalist nature. This does not necessarily mean that the imperial mode of living is leading into a great crash. The limits are not absolute (...) The authoritarian stabilization of the imperial mode of living is not the only strategy to cope with the multiple crises and to shift the limits to capitalist nature in an exclusive manner. Another one (...) is the selective ecological modernization of the imperial mode of living which may result in what can be called a *green capitalism.*”

Brand, Ulrich; Markus Wissen (2018): *The limits to capitalist nature. Theorizing and overcoming the imperial mode of living*, Rowman & Littlefield, London.

90. Total extractivism: ‘techno-capitalist transformation engulfing the planet’

“The earth and its inhabitants are on a trajectory of cascading socio-ecological crisis driven by techno-capitalist development (...) Total extractivism denotes how the techno-capitalist world system harbors a rapacious appetite for all life—total consumption of human and non-human resources—that destructively reconfigures the earth.”

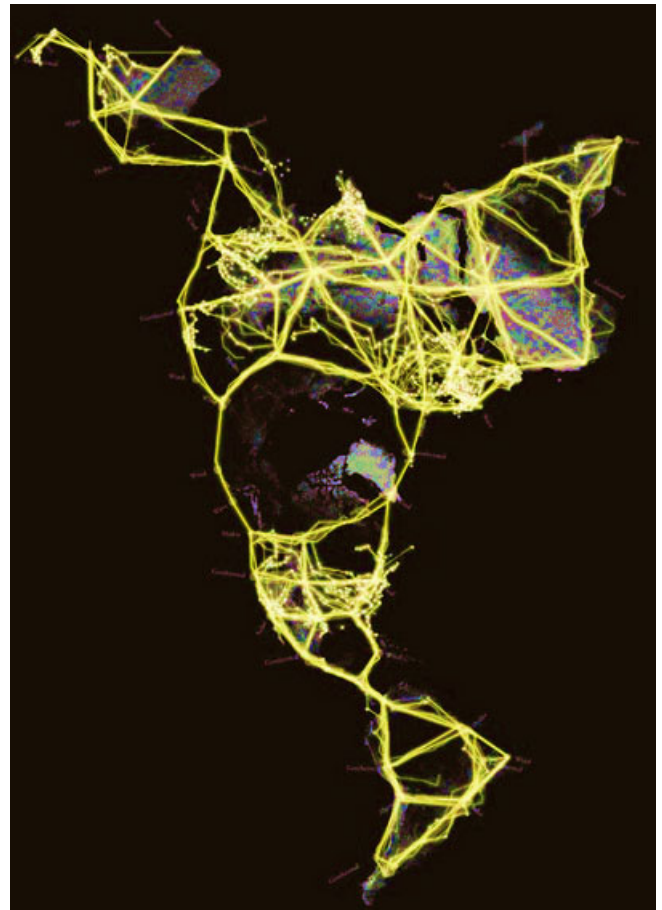
“Total extractivism (...) is the imperative driving the global capitalist economy, centered on the deployment of violent technologies aiming at integrating and reconfiguring the earth and absorbing its inhabitants, meanwhile normalizing its logics, apparatuses and subjectivities, as it violently colonizes and pacifies various natures (...) The technocapitalist system indeed has the tension of *totalizing*. It harbors a rapacious appetite for all life, desiring the total consumption and reconfiguring of the earth centered on bureaucracy, industrial/cybernetic production and market relations that maintains a hyper-destructive growth imperative that produces a grotesque earthly product. Capitalism—past, present and future—attempts to devour all vitality: plants, animals, humans, hydrocarbons, minerals and just about anything ‘seen’, valued or revalued by the state and its appendages. Capitalism, in other words, colonizes the earth as it appropriates, expropriates and extinguishes the entirety of the earth’s resources.”

“This World System—this techno-capitalist industrial system—is in fact a monster.”

“The highest priority of the Worldeater, or the imperative of technocapitalist industrial progress, is thus acquiring, transforming and controlling natural resources, frequently deemed a ‘strategic’, ‘critical’ or a ‘national security’ interest.”

“The Worldeater—techno-capitalist progress—exists and subsists on war, violence and trauma (...) If there is one thing the long techno-capitalist trajectory (...) teaches us, it is that we should not underestimate the cunning, shapeshifting and ever-evolving ability to devise new violent technologies that not only repress human agency, but also possess it. Social engineering is a technical term for possessing human agency. The Worldeater is a conversation of possession, addiction, dependency and blindness that are accomplished through civil-military interventions (...) and solidified by politics.”

“The imperative of total extractivism, moreover, reveals the false claims of ‘greening’ as the renewable energy-extraction nexus suggests. The green economy emerges as a worldeating device and a violent technology of extraction. Few fabrications are more successful at present than the pretensions of this green economy.”



Global energy networks

Dunlap, Alexander; Jostein Jakobsen (2020): *The violent technologies of extraction. Political ecology, critical agrarian studies and the capitalist worldeater*, Palgrave Macmillan, Cham, Switzerland.

**“Treat the earth well. It was not given to you by your parents.
It was loaned to you by your children.”**
—Native American proverb (quoted in Slavín, 2017, ch. 6)

91. The psychological climate paradox

“We know that climate science facts are getting more solidly documented and disturbing year by year. We also know that most people either don’t believe in or do not act upon those facts. It forces the simple question: *Why?*”

Stoknes, Per Espen (2015): *What we think about when we try not to think about global warming: Toward a new psychology of climate action*, Chelsea Green Publishing, White River Junction, VT.

92. Herman Daly’s Impossibility Theorem

“It is impossible for the world economy to grow its way out of poverty and environmental degradation. In other words, sustainable growth is impossible.”

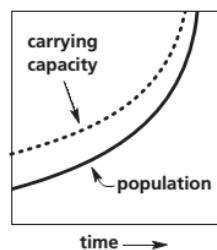
93. Magdoff and Foster (2011, p. 7) corollary to Herman Daly's Impossibility Theorem

Magdoff and Foster (2011, p. 7) corollary to Herman Daly's Impossibility Theorem of unlimited economic growth in a limited environment: "The continuation for any length of time of capitalism, as a grow-or-die system dedicated to unlimited capital accumulation, is itself a flat impossibility". "We are constantly being told by the vested interests (...) that capitalism offers the solution to the environmental problem: as if the further growth of capital markets, green consumption, and new technology provide us with miraculous ways out of our global ecological dilemma. Such views are rooted in an absolute denial of reality."

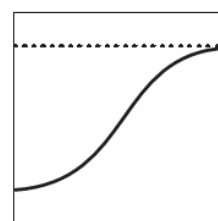
Magdoff, Fred; John Bellamy Foster (2011): *What every environmentalist needs to know about capitalism. A citizen's guide to capitalism and the environment*, Monthly Review Press, New York.

94. Dynamics of World3 (Meadows et al., 2005, ch. 4)

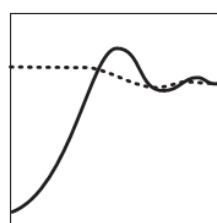
- **World3.** World3 is a model of the world economy by Meadows et al. (2005) "to understand the broad sweep of the future": the ways in which the world economy will interact with the Earth's carrying capacity over many decades.
- **Ways to approach the carrying capacity.** Continuous growth, convergence to the carrying capacity from below, overshoot with cyclical convergence and overshoot followed with collapse (see the chart on the right). The authors believe that the world economy is already above the Earth's carrying capacity (overshoot).
- **Feedback loops.** Figs. 1 and 2 below show the feedback relationships regulation population growth and capital accumulation. Fig. 1 displays the connection between population and capital that goes through agriculture; Fig. 2, the one that goes through resources and services.
- **Scenario 1.** In Scenario 1 (see Fig. 3) the computer model World3 is run with parameter values that represent the continuation of the path the world economy followed during the 20th century. Population and production increase until the resource limit is reached. The impossibility of maintaining resource flows lead to a fall in output and life expectancy and a rise in death rates.
- **Scenario 6.** In Scenario 2 (see Fig. 4) the economy develops simultaneously (costly) technologies for pollution abatement, land yield enhancement, land protection, and conservation of nonrenewable resources. Full implementation of these technologies takes two decades but in the end the economy is relatively large and prosperous (though below the top level ever reached).



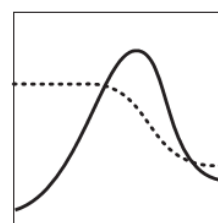
a) Continuous Growth



b) Sigmoid Approach to Equilibrium



c) Overshoot and Oscillation



d) Overshoot and Collapse

Meadows, Donella; Jorgen Randers; Dennis Meadows (2005): *Limits to growth. The 30-year update*, Earthscan, London.

95. How much can be learned from the rise and fall of the Roman empire?

- The Romans were unabashed borrowers. The Roman republic was another citizenship-based political experiment with particular ingredients: religious piety, civic sacrifice, militarism, and legal and cultural mechanisms to incorporate former enemies as allies and citizens. The Romans handled success (the acquisition of massive amounts of wealth from the conquests) successfully. The grand strategy consisted in integration: The Romans ruled through cities and their elites. Local elites across three continents collected taxes to maintain the empire and, in exchange, were allowed to enter the Roman governing class. The durability of the empire depended on that agreement. The stability of the pact made the empire stable, which enabled demographic and economic expansion, which reinforced the empire's power.
- **In the period AD 150-450, one of the most dramatic sequences of climate change appears to have pressed to the limit the empire's resilience.** The fall of the Roman empire is the single greatest regression in all of human history (Ian Morris). The Rise of the West is arguably a side-effect of the extraordinarily successful and long-lasting experiment that was the Roman empire.

Harper, Kyle (2017): *The fate of Rome. Climate, disease, and the end of an empire*.

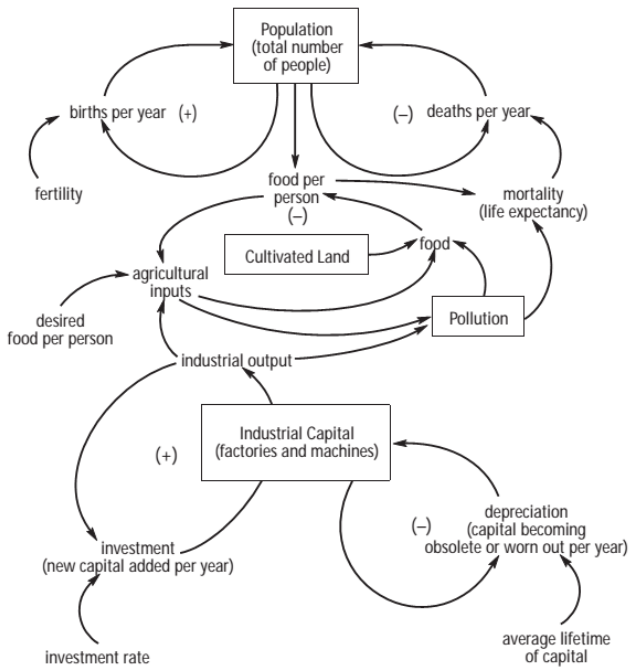


Fig. 1. Feedback Loops of Population, Capital, Agriculture, and Pollution (Meadows et al., 2005, p.144)

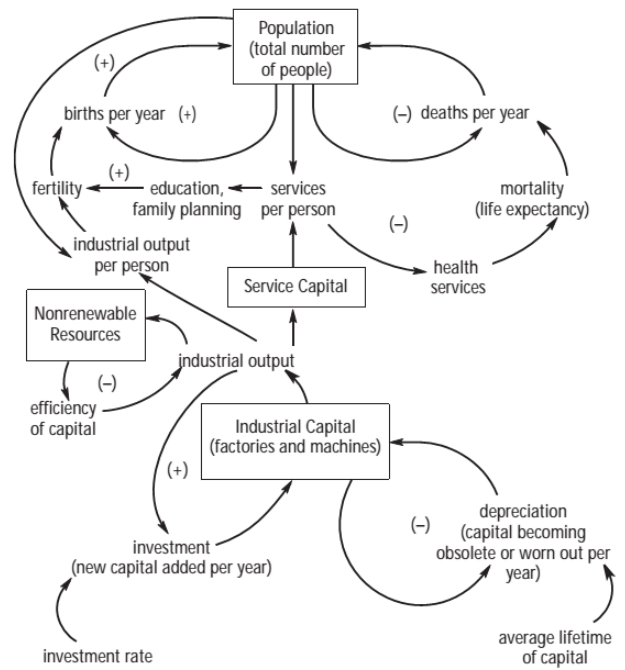


Fig. 2. Feedback Loops of Population, Capital, Services, and Resources (Meadows et al., 2005, p.145)

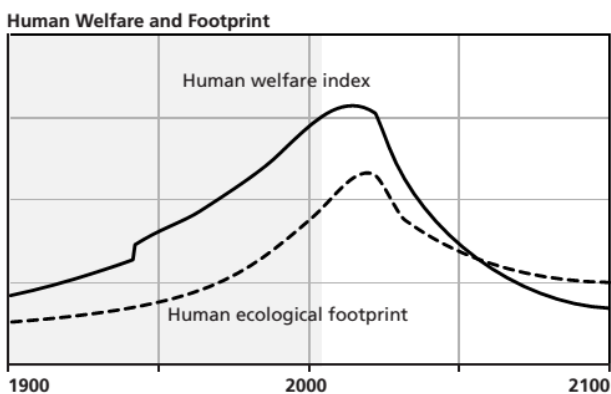
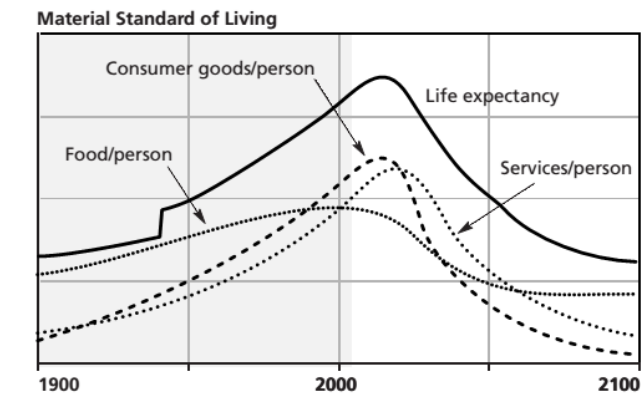
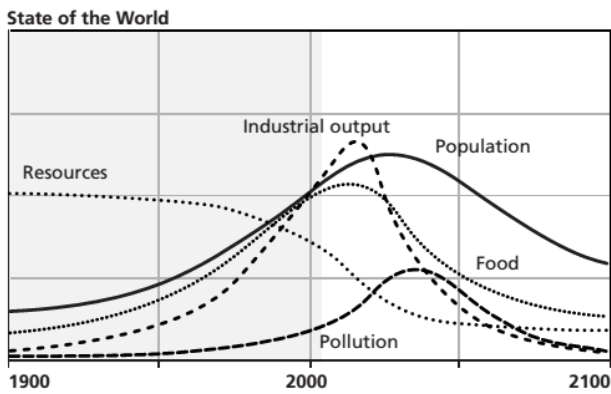


Fig. 3. Scenario 1 of World3 (Meadows et al., 2005, p.169)

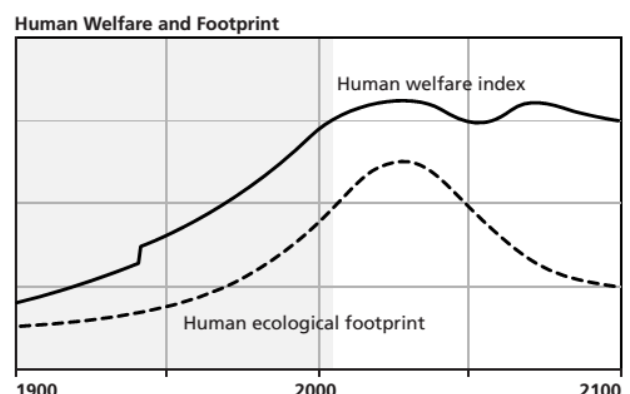
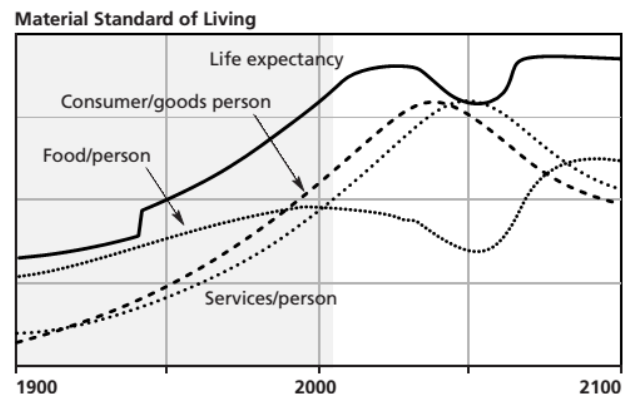
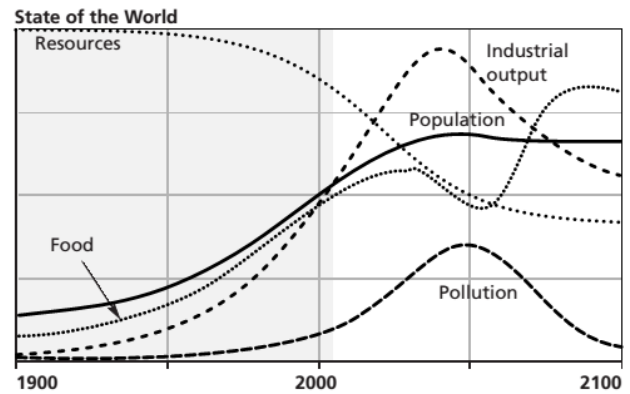
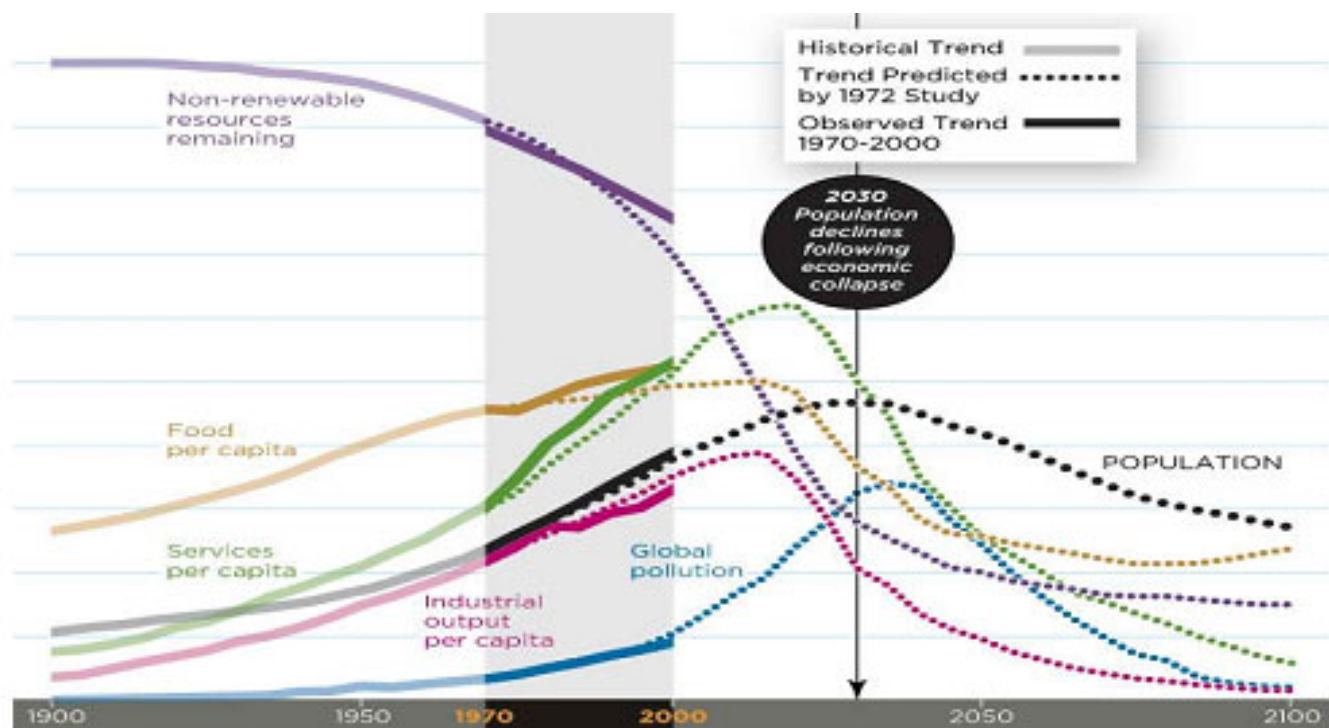


Fig. 4. Scenario 6 of World3 (Meadows et al., 2005, p.219)

96. The Limits to Growth model prediction vs reality



The Limits to Growth Standard Run, from World 3 model, with update to 2000

“A comparison of The Limits to Growth with 30 years of reality”, *Journal of Global Environmental Change*, 2008, 387-411, <http://www.smithsonianmag.com/science-nature/Looking-Back-on-the-Limitsof-Growth.html>

Maxton, Graeme (2019): *Change! Why we need a radical turnaround*, 2nd edition, Komplet-Media.

97. The mineral resource crisis (Kesler and Simon, 2015)

- **Mineral dependence.** Advanced societies depend crucially on the consumption of mineral resources (metals, fossil fuels, mineral fertilizers). The global footprint of a smartphone: uses more than 40 elements (aluminum, potassium, and silicon for the screen; carbon, cobalt, and lithium for the batteries; indium and tin to conduct electricity in the touch screen; nickel for the microphone; lead and tin, solders; antimony, arsenic, boron, phosphorus, and silicon in semiconductors and chips; oil for the plastic housing; bromine in the plastic for fire retardation; copper, gold, and silver in the wiring; tantalum for the capacitors; the rare-earth elements gadolinium, neodymium, and praseodymium for the magnet, neodymium, dysprosium, and terbium to reduce vibration, and dysprosium, gadolinium, europium, lanthanum, terbium, praseodymium, and yttrium to produce colors); these elements are produced in distant places (almost 90% of the rare earths are mined in China, lithium in Chile, cobalt in the Democratic Republic of Congo, aluminum in Australia, phosphorus in Morocco, nickel in Canada); in 2015, nearly 5 billion people owned a mobile phone.
- **Current threats to the mineral supplies: growing demand.** With China and India being the largest consumers of mineral resources, it might be that mineral will be exhausted sooner than expected (China, representing 20% of world population, consumes 49% of world coal, 46% of world steel, 43% of world aluminum, 34% of world copper, and 11% of world oil). With growing population, a growing mineral consumption is needed to maintain per capita production.
- **Current threats to the mineral supplies: environmental costs.** Extraction and consumption of mineral resources have increased pollution and environmental degradation/destruction (global warming, acid rain, destruction of the ozone layer, pollution of groundwater).
- **Responses to the threats.** (1) Decrease mineral consumption and increase recycling and conservation. (2) Invest more in exploration to find new sources/resources and in new extraction techniques.

Kesler, Stephen E.; Adam Simon (2015): *Mineral resources, economics and the environment*, Cambridge University Press, Cambridge, UK.

98. How to reduce the ecological footprint

“What then should the objective be, and how can societies make the transition? The challenge is to reduce the ecological footprint, to bring it back into balance with nature, and then keep it there.”

“In broad-brush terms humanity needs to adopt the following goals:

- Shut fossil (...)
- Skies without planes, roads without cars (...)
- No more cement (...)
- Make plastic pay (...)
- Hug trees (...)
- Think local, act local. Radically reform agricultural food production, including fishing, so that it is localised, and on a sustainable scale which does not damage nature, regardless of the economic effect on food manufacturers, food costs and retailers. Develop a welfare support system to help consumers during the transition and ensure that no one starves or suffers clinically as a result (...)
- Cut off the gases (...)
- Build better (...)
- AC DC everywhere (...)
- Free ride. Invest heavily in the rail infrastructure to provide a more sustainable system of mobility than cars and trucks. Consider free public transport for all.
- Take and give. Shift all planned future investments in fossil energy over the next 20 years to the renewables sector (...)
- Work together. Establish an international agency to protect the oceans and repair the damage that has been done to them. Prosecute those responsible.
- Rethink and recapture. Increase investment in biosequestration, soil carbon storage, reforestation and sustainable urban design. Invest heavily in waste management to ease the burden on the world’s rivers, soils and oceans.
- The world before weapons (...)
- Make the guilty pay.”

Maxton, Graeme (2019): *Change! Why we need a radical turnaround*, 2nd edition, Komplet-Media.

99. Why the lack of response to ecological challenges? (Maxton, 2019)

“Why then has humanity failed to respond to the challenge it faces? (...) For people in the rich world under 40, this is mostly a question for your parents. They are mostly to blame for the place where humanity now finds itself. The post-war generation knew deep down that they were living unsustainably. They knew that flights for a few euros did not make sense, that so much plastic packaging was not necessary and that throw-away fuelled consumption was needlessly wasteful. They understood that climate change was a serious problem. They knew and yet most of these people did nothing. Something similar has happened before, of course. During the Second World War, the Chinese Cultural Revolution and for parts of the Soviet era people looked away while many innocent lives were lost. Today, it is hundreds of millions of people who have chosen to ignore the destruction and injustice that surrounds them. They have turned a blind eye to the death of so many animals, fish and birds, vast plastic islands in the oceans, runaway consumption, rising selfishness, declining liberty, higher temperatures and widening inequality (...) The difference this time is that the threat is global and existential.”

“Humanity has also failed to act because it feared the financial cost, even though the wealth at risk is mostly just numbers on machines. The fear of these numbers being reduced, and the effect this would have on the rich, has been a huge disincentive for change (...) Societies have also failed to respond because the time has not been right (...) Society has also failed to act for more excusable reasons. The challenge is very hard to understand, and very long term, while the human world focusses mostly on the short term. There is also the slow impact of nature’s feedback loops, which make it hard for most people to grasp the urgency. Part of the problem too has been the ‘scholarly reticence’ of climate scientists, who have feared seeming unscientific or alarmist.”

100. Three responses by the world's political leaders to global warming political dilemma.

- **Plan A:** business as usual indefinitely, until the Earth becomes hell and civilization extinguishes (the plan currently followed).
- **Plan B:** the equivalent to a wartime mobilization to cut carbon emissions rapidly and restructure the world energy economy: "if Plan B is carried out, living in our world will be, while unpleasant, not hell – physicist Joe Romm has called it 'Planetary Purgatory.'"
- **Plan C:** "the present political leaders of the United States – along with those of China, the other chief emitter of CO₂– will delay. Thinking that the scientists' predictions might be wrong, they take a wait-and-see approach."

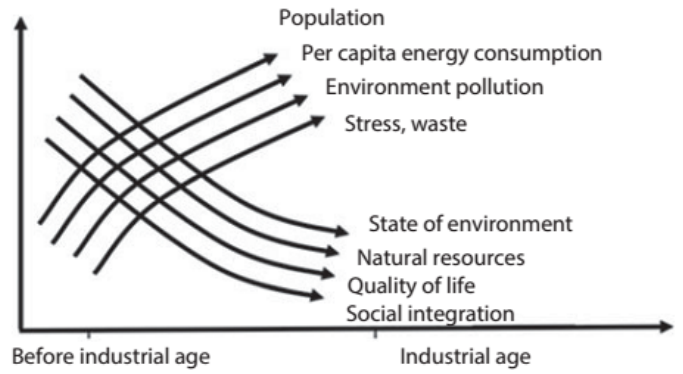


Figure 3.8 Our current epoch is an epic failure of intangible values.

"It is possible that, although Plan C would result in a hellish existence, it might allow us, if we are lucky, to avoid extinction. More likely, however, the results would ultimately be no different from those of Plan A. The only rational option, therefore, is Plan B."

Griffin, David Ray (2015): *Unprecedented: Can civilization survive the CO₂ crisis?*, Clarity Press

Jaan S. Islam, M.R. Islam, Meltem Islam, M.A.H. Mughal (2018): *Economics of sustainable energy*, Wiley.

Figure 3. Trend in CO₂ emissions from fossil fuel combustion, 1870-2014

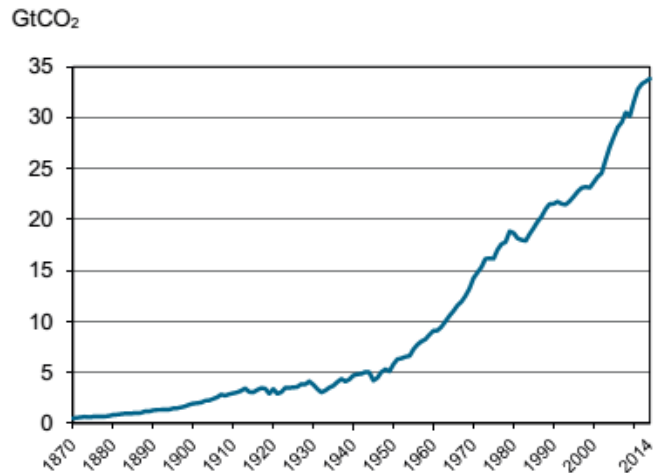


Figure 1. Estimated shares of global anthropogenic GHG, 2014

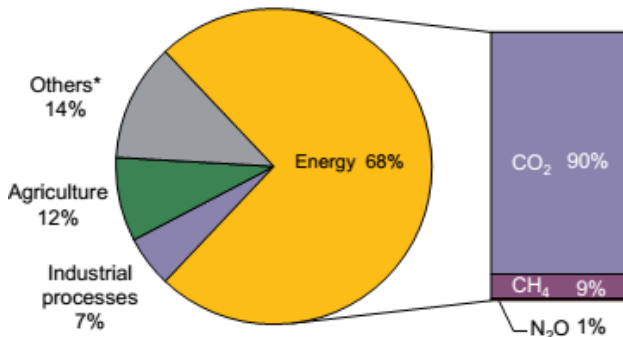


Figure 8. CO₂ emissions by region, 2015

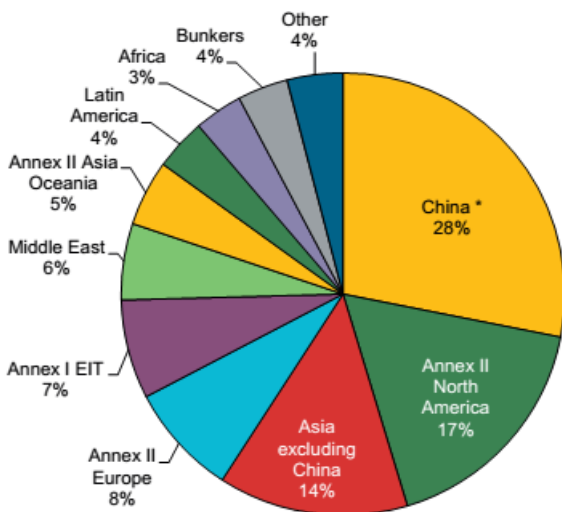


Figure 10. World CO₂ emissions from fuel combustion by sector, 2015

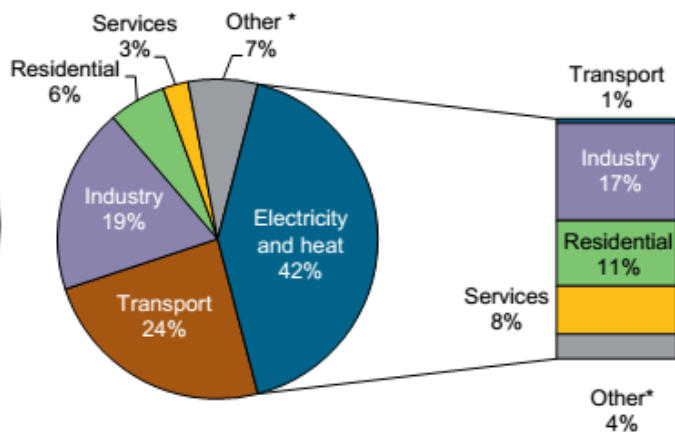


Figure 15. Trends in CO₂ emission intensities for the top five emitting countries*, 1990-2015

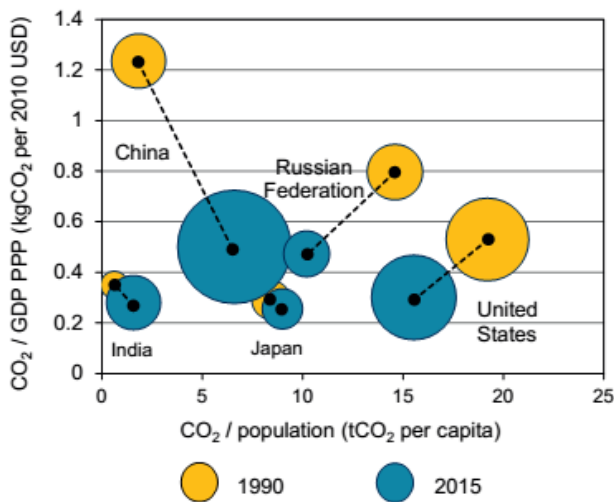
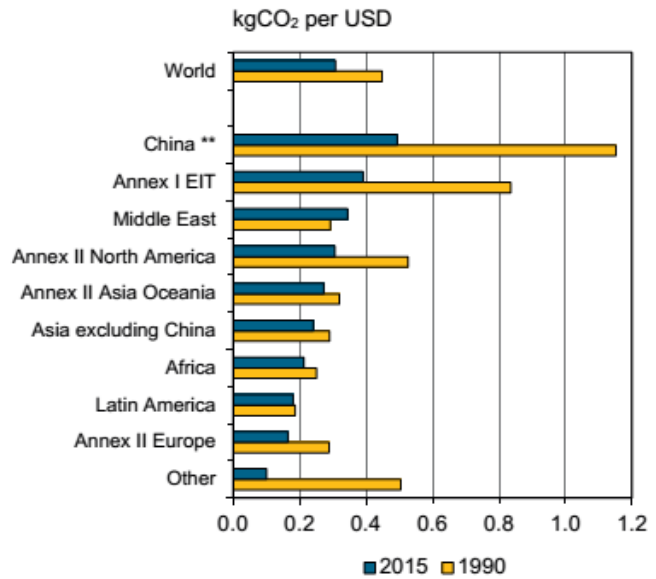


Figure 16. CO₂ emissions per GDP* by major world regions, 1990-2015



OECD/International Energy Agency (2017): CO₂ emissions from fuel combustion 2017.

101. Environmental Kuznets curve

“When these economists plotted pollution of different kinds on the vertical axis and per capita income on the horizontal axis, they also found an empirical relationship that took the shape of an inverted U, suggesting an initial positive relationship between economic growth and pollution that at some point reversed, after which higher per capita income was associated with lower levels of pollution. Their inverted U-shaped curve is the famous, misnamed ‘environmental Kuznets curve’ (...) Just as proponents of trickle-down economics used Kuznets’ own inverted U-shaped curve to argue against the need for policies designed to reduce economic inequality, others have cited the environmental Kuznets curve as evidence that environmental problems are merely a transitional phenomenon that economic growth will eventually resolve.”

102. I = PAT

“Ecological economists like to begin with the equation I = PAT, where I stands for environmental impact (which ecological economists think of as throughput), P stands for population, A stands for affluence (which ecological economists define as per capita consumption, but we can think of as per capita income for purposes of comparison with the environmental Kuznets curve), and T stands for technology, meaning new technologies that increase ‘throughput efficiency,’ such as increases in ‘energy efficiency.’ In terms of growth rates, the I = PAT equation says that throughput will grow at a rate equal to the sum of the population growth rate and the rate of growth of per capita GDP, minus the rate of growth of throughput efficiency.”

103. The Coase theorem

“Regardless of whether the polluter or pollution victim is assigned the property right, voluntary negotiation should yield the efficient outcome. This is the typical presentation of the Coase theorem in textbooks. All textbooks acknowledge, as did Coase, that negotiations are likely to fail in the presence of high *transaction costs* (...) The Coase theorem is widely interpreted, not only by free-market environmentalists but by the authors of economics textbooks as well, as ‘proving’ that efficient outcomes can result even in the presence of externalities as long as property rights are clear, independent of who has them. For example (...) “The Coase theorem states that if property rights are well defined, and no significant transaction costs exist, an efficient allocation of resources will result even with externalities.” (Jonathan Harris)

“It is reasonable to describe Coasian negotiations as the laissez-faire solution to the problem of externalities and as an alternative to government intervention. However, it is inaccurate and misleading to describe Coasian negotiation as a market process.”

“The main reasons voluntary negotiations between polluters and their victims will not lead to efficient outcomes are not because of positive transaction costs or irrational behavior, but because negotiators seldom know their opponent’s true situation, which leads to perverse incentives to dissimulate, and because the existence of multiple victims creates perverse incentives for victims to free ride, hold out, and misrepresent the extent of damages (...) The realm of real-world situations where voluntary negotiations could be reasonably expected to provide efficient solutions to environmental problems is so small that free-market environmentalism no more deserves a seat at the policy table than miracles deserve a role in the operating room.”

Hahnel, Robin (2011): *Green economics. Confronting the ecological crisis*, Routledge

See chapter 7: Real-world environmental policy and chapter 8, A brief history of climate negotiations

104. The Coase theorem

“Let exclusive property titles to the environment be defined, and let them be transferable. Let there be no transaction costs. Let individuals maximize their utilities, and let them be non-altruistic. Then a bargaining solution among different users of the environment will result in a Pareto-optimal allocation of the environment. The resulting allocation is independent of the initial distribution of property titles.”

Siebert, H. (2008): *Economics of the environment*, Springer, Berlin.

Wiesmeth, Hans (2012): *Environmental economics. Theory and policy in equilibrium*, Springer, Berlin.

“The negotiations are currently still in a deadlock because short-term national interests are blocking a prompt and effective global climate protection agreement...”

German Advisory Council on Global Change (WBGU) (2009): *Solving the climate dilemma. The budget approach*, Berlin.

“...the reasons for Americans’ failure to recognize the great significance of climate change is that we are wedded to an economic model and practices that privilege competition over cooperation, selfish pursuits over promoting the common good, and greed over generosity. Ingrained in American society and practices are emphases on “big”, “fast”, “efficient”, “competitive”, and “profitable.” We Americans have not especially privileged “sustainable” in our communities, society, and economy.”

Judith Blau (2017): *The Paris Agreement. Climate change, solidarity, and human rights*, Palgrave Macmillan, Cham, Switzerland.

“... Pericles wisely observed that ‘where there is no vision, the people shall perish.’ Today, a lack of vision with respect to climate change adaption and mitigation will lead to populations and nations that indeed perish from flooding, drought, health crises and environmental destruction. The signs are clear and undeniable in all parts of the world where weather phenomena triggered by climate change are becoming increasingly evident and dangerous. Climate projections for the year 2100 are daunting...”

Ross Michael Pink (2018): *The climate change crisis. Solutions and adaption for a planet in peril*, Palgrave Macmillan, Cham, Switzerland.

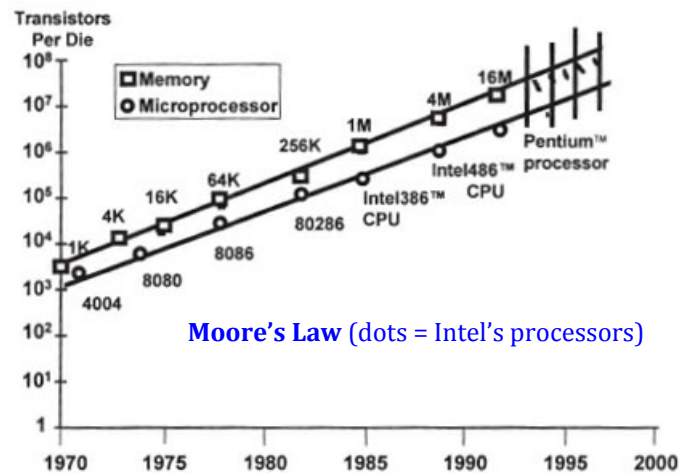
105. Ecological overshoot (World Wildlife Fund)

Ecological overshoot “occurs when humanity’s demand on nature exceeds the biosphere’s supply, or regenerative capacity” (Global Footprint Network 2009)

III. Technology and global integration

106. Moore's law (Gordon Moore, 1965)

"Moore's Law, the biennial doubling of computer chip performance that had accelerated the pace of innovation and become the metronome of the modern world (...) guaranteed that change would be so central to modern life that there would be precious little time left for nostalgia. When you are being chased by demons, your only chance of survival is to keep racing forward as fast as you can; looking back can only scare you. Worse, as Moore's Law had been warning for a half century now, it wasn't even enough just to go fast. Rather, you had to go faster and faster, progressing at a pace humanity had never before known, just to keep up (...) And through Intel's products and commitment to Moore's Law, they [Gordon Moore and Andy Grove] had made possible the consumer electronics revolution that now defined the lives of three billion people, with millions more joining every day. Humanity was now richer, healthier, smarter, and more interconnected than ever before because of what they achieved." (Malone, 2014)



"Moore's Law is the product of human imagination. The phrase Moore's Law is known around the world as a technical observation, one that describes the development of digital electronics and computing (...) In April 1965 (...) Moore described how the chemical printing of microchips was open ended. If investment was made, technology would advance, and such investment would reward microchip makers handsomely. It was a win-win situation. By shrinking transistors, and putting more of them into individual microchips, everything became better: as chips became both better and less expensive, use would spread. Moore presciently envisaged the world we know today, 'such wonders as home computers, automatic controls for automobiles, and personal portable communications equipment.' (...) Since 1959 (...) the number of transistors on a chip had doubled each year, so that microchips now incorporated more than 50 transistors each. Moore predicted this dynamic would continue for the coming decade. By investing in chemical printing technology, doubling transistor counts each year, and shrinking cost (...) manufacturers would in 1975 be making microchips containing not 50 but 65,000 transistors. This was the first formulation of Moore's Law, displaying its essence." (Thackray et al., 2015)

"By 1975 Moore was CEO of Intel, and microchips did contain 65,000 transistors (...) Moore predicted that in the decade ahead, with mechanisms to develop the technology becoming more expensive, the 'annual doubling law' would slow to a doubling every eighteen months. By 1985 microchips with 16 million transistors would represent the cheapest form of electronics. And so it went. Today, the transistor on a microchip has become the most manufactured object in all of history. Transistors now produced in a single year most likely exceed the proverbial grains of sand upon all the seashores of the world. The price of computing has fallen well over a millionfold, while the cost of electronics components has shrunk more than a billionfold." (Thackray et al., 2015)

"Microchip complexity has increased at a metronomic pace for the past six decades, as Moore's Law is everywhere observed. That 'law' is a social product, inspired by imagination, made possible through experience, and enforced through the cooperative and competitive efforts of the global semiconductor industry. The development of chemical printing and the design of complex microchips have required the investment of many billions of dollars and the coordinated effort of hundreds of thousands of people, through the organizing interventions of consortia, conferences, and 'technology road maps.' In the history of technology, the silicon transistor within the microchip ranks alongside the steam railroad, the automobile, and the airplane in its revolutionary impact." (Thackray et al., 2015)

"Moore's Law is unique: the deliberate human creation of an unusually regular pace of unusually rapid change. We take this for granted and enjoy it. But it will not last. 'All good exponentials come to an end,' observes Moore. He has long glimpsed the eventual emergence of fundamental barriers. On the technical side, it is impossible to print chemically a feature that is smaller than an atom (in 2015 some features of transistors on microchips are just tens of atoms thick). More significantly, Moore foresees disruption in the economic side of Moore's Law. The growing expense of ever more exacting manufacturing technology, in factories costing several billion dollars

apiece, will erode economic incentives, slowing to a crawl the future career of the microchip.” (Thackray et al., 2015)

Malone, Michael S. (2014): *The Intel trinity. How Robert Noyce, Gordon Moore, and Andy Grove built the world's most important company*, Harper Business, New York.

Thackray, Arnold; David C. Brock; Rachel Jones (2015): *Moore's law. The life of Gordon Moore, Silicon's Valley quiet revolutionary*, Basic Books, New York.

107. Moore's law (Gordon Moore, 1965)

Expression that captures a technical observation regarding the development of digital electronics and computing. In 1965 Gordon E. Moore predicted that the number of circuit elements on a one square centimetre chip would double every 1.5 years: he prophesized that new methods would make microchips smaller, more reliable, less power hungry and cheaper. His prediction seems to have hold for more than fifty years: in effect, by shrinking transistors and putting more into a microchip, chips have become better, faster, less expensive and their use has spread. A general formulation of the law is that “the level of chip complexity that can be manufactured for minimal cost is an exponential function that doubles in a period of time”. Economically speaking, the law states that technological evolution increases the number of components (hence, provides greater functionality) for the same cost. The exponential improvement of technology has not been limited to microchips, but also to the capacity of computer memories, the speed of data transmission and the number of pixels in digital photography. The question is for how long Moore's observation is going to hold: he himself said that “All good exponentials come to an end”.

Thackray, Arnold; David C. Brock; Rachel Jones (2015): *Moore's Law. The life of Gordon Moore, Silicon Valley's quiet revolutionary*, Basic Books, New York.

Huff, Howard (ed) (2009): *Into the nano era. Moore's Law beyond planar silicon CMOS*, Springer, Berlin.

108. Moore's law of everything (Samuel Arbesman, 2013)

“... there are regularities in these changes in technological knowledge. It's not random and it's not erratic. There is a pattern, and it affects many of the facts that surround us, even ones that don't necessarily seem to deal with technology. The first example of this? Moore's Law.”

“These technological doublings in the realm of science are actually the rule rather than the exception. For example, there is a Moore's Law of proteomics, the field that deals with large-scale data and analysis related to proteins and their interactions within the cell. Here too there is a yearly doubling in technological capability when it comes to understanding the interactions of proteins (...) So while exponential growth is not a self-fulfilling proposition, there is feedback, which leads to a sort of technological imperative: As there is more technological or scientific knowledge on which to grow, new technologies increase the speed at which they grow.

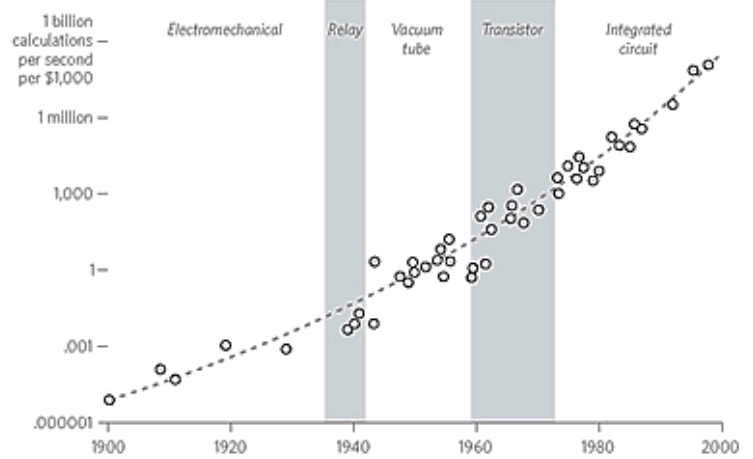
“These doublings have been occurring in many areas of technology well before Moore formulated his law. As noted earlier, this regularity just in the realm of computing power has held true as far back as the late nineteenth and early twentieth centuries, before Gordon Moore was even born. So while Moore gave a name to something that had been happening, the phenomenon he named didn't actually create it. Why else might everything be adhering to these exponential curves and growing so rapidly? A likely answer is related to the idea of cumulative knowledge. Anything new—an idea, discovery, or technological breakthrough—must be built upon what is known already. This is generally how the world works. Scientific ideas build upon one another to allow for new scientific knowledge and technologies and are the basis for new breakthroughs. When it comes to technological and scientific growth, we can bootstrap what we have learned before toward the creation of new facts. We must gain a certain amount of knowledge in order to learn something new (...) We should imagine that the magnitude of technological growth is proportional to the amount of knowledge that has come before it. The more preexisting methods, ideas, or anything else that is essential for making a certain technology just a little bit better, the more potential for that technology to grow.”

Arbesman, Samuel (2013): *The half-life of facts. Why everything we know has an expiration date*, Current, New York.

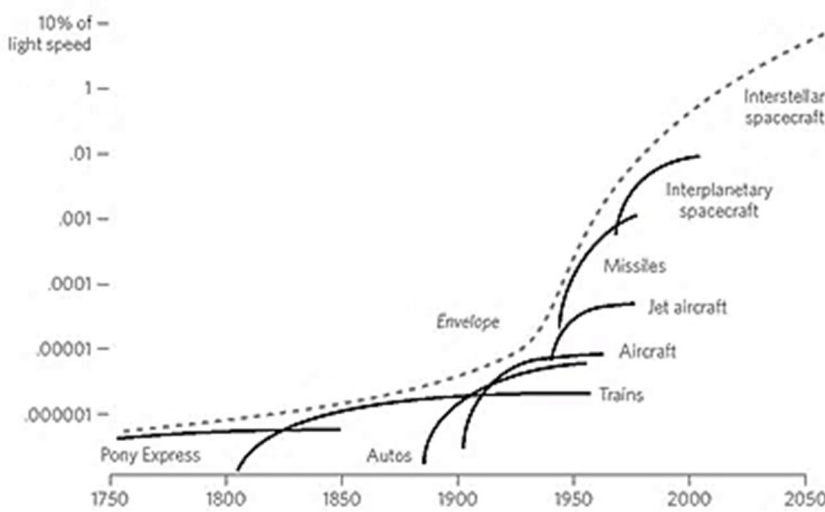
109. The paths of technology

“...we do have three types of evidence strongly suggesting that the paths of technologies are inevitable:

1. In all times we find that most inventions and discoveries have been made independently by more than one person.
2. In ancient times we find independent timelines of technology on different continents converging upon a set order.
3. In modern times we find sequences of improvement that are difficult to stop, derail, or alter.”



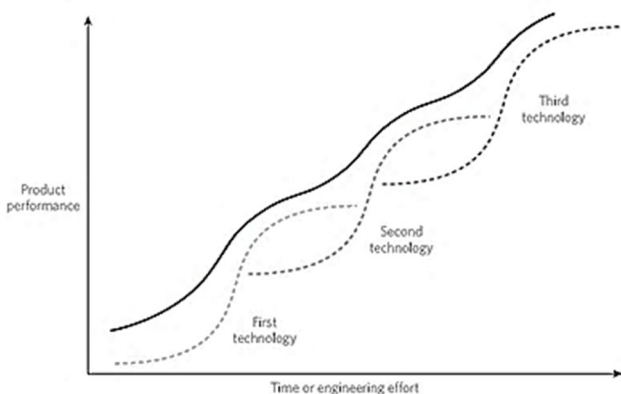
“Kurzweil’s Law. Ray Kurzweil translated earlier calculating methods into a uniform metric of computation to yield a steady foreshadowing of Moore’s Law”



“Speed Trend Curve. The U.S. Air Force’s plot of historical speed records up to the 1950s and their expectations of the fastest speeds in the near future.”

“The kind of inevitability I am speaking of here in the digital realm is the result of momentum. The momentum of an ongoing technological shift. The strong tides that shaped digital technologies for the past 30 years will continue to expand and harden in the next 30 years. These apply to not just North America, but to the entire world (...) Change is inevitable (...) At the center of every significant

change in our lives today is a technology of some sort. Technology is humanity’s accelerant. Because of technology everything we make is always in the process of becoming. Every kind of thing is becoming something else, while it churns from ‘might’ to ‘is.’ All is flux. Nothing is finished. Nothing is done. This never-ending change is the pivotal axis of the modern world.” Kelly (2016)



“Compound S Curves. On this idealized chart, technological performance is measured on the vertical axis and time or engineering effort captured on the horizontal. A series of sub-S curves create an emergent larger-scale invariant slope.”

TECHNOLOGY	METRIC	MONTHS
Fiber-optic throughput	Wavelengths per fiber	9
Optical network	Dollars per bit	9
Wireless	Bits per second	10
Communication	Bits per dollar	12
Magnetic area storage	Gigabits per square inch	12
Digital cameras	Pixels per dollar	12
Microprocessor	Dollars per cycle	13
Supercomputer power	FLOPS	14
RAM	Mebibytes per dollar	16
Transistor	Dollars per transistor	18
PCU power consumption	Watts per square centimeter	18
Pixels	Per array	19
Hard-drive storage	Gigabytes per dollar	20
Chip	MIPS	21
DNA sequencing	Dollars per base pair	22
Trunk-line data speed	Bits per second	22
Microprocessor	Transistors per chip	24
Chip processor	Megahertz per dollar	27
Bandwidth	Kilobits per second per dollar	30
Microprocessor	Hertz	36

“Doubling Times. Performance ratios of various technologies measured as the number of months required to double their performance.”

Kelly, Kevin (2016): *The inevitable: Understanding the 12 technological forces that will shape our future*, Viking, New York.

Kelly, Kevin (2010): *What technology wants*, Viking, New York.

110. Law of accelerating returns (Ray Kurzweil)

The rate of evolution inherently accelerates, shows continual acceleration (every stage in evolution uses the capabilities and results from the previous stage and, for each stage, going from one stage to the next takes a shorter time).

111. Six epochs of evolution (Ray Kurzweil)

These epochs express the continued evolution of information: physics and chemistry (information captured by patterns of matter and energy); biology and DNA (self-replicating mechanisms created: life); brains (mechanisms to acquire and process information biologically); technology (human creations); merger of human technology with human intelligence; and “the universe wakes up” (“the ‘dumb’ matter and mechanisms of the universe will be transformed into exquisitely sublime forms of intelligence, which will constitute the sixth epoch in the evolution of patterns of information. This is the ultimate destiny of the Singularity and of the universe”, Kurzweil, 2005, ch.1).

112. The Singularity (Ray Kurzweil)

It is the era defined by intelligence becoming nonbiological and countless of times higher than the current level of human intelligence as a result of rapid technological change. The impact of this change will transform human life: biological limitations will be transcended out, creativity will be amplified, humans and machines will become integrated, we could occupy different bodies and all human problems will be solved (aging, illness, pollution, hunger, poverty... even death). Nanotechnology will make it possible to produce anything inexpensively. The Singularity culminates the merger of biology with technology: it is the time when machine intelligence merges with, and surpasses, human intelligence.

113. Technological singularity

“The coming of a Technological Singularity is one of the most exciting and controversial predictions to emerge in recent decades. As posited by influential writers and thinkers such as Ray Kurzweil, Vernor Vinge, and Peter Diamandis, this will be a point in time when revolutionary advances in science and technology happen too rapidly for the human mind to comprehend. After the Singularity, these pundits predict, robots or other machines will have greater general intelligence than humans. These post-human intelligences would be able to 3D print any form of ordinary matter at low cost. They could cure diseases and perhaps even abolish aging. On the other hand, there are also darker possibilities – they could decide to wipe out human beings altogether, or just keep a few of us in a zoo for their amusement (...) Some key questions (...) are:

- Artificial General Intelligence (AGI) fairly rapidly achieves massively superhuman intelligence, or does it remain somewhere in the vicinity of the human level?
- Will some sort of global AGI Nanny emerge, providing control or regulation of intelligence on the planet, or does governance remain in the hands of (some form of) humans?
- To what extent will a Global Brain with its own coherent, emergent intelligence arise and become a dominant actor on the planet, as opposed to the main nexus of choice and causation being individual humans or human-scale AGIs?
- To what extent will “mindplexes” or group minds emerge, perhaps on a smaller scale than a Global Brain?
- Will future humans have an experience of scarcity or abundance? That is: will future humans react to the abundance of free “basic needs,” as understood today, with a fixation on competing to acquire more advanced goods and services that remain scarce even as a Singularity approaches, and maybe even thereafter?
- What will people do all day, if they no longer have a need to work in order to acquire scarce resources?

- How will the exchange of desired scarce resources, if any exist, occur in the future? With some future form of money? Or via some different sort of system?
- Will privacy exist in the future?"
- Will humans be annihilated by advanced machines?
- Will there be large-scale military conflicts between those advocating accelerating technological change, and those opposing it?

Goertzel, Ben; Ted Goertzel (2015): "Introduction," in Goertzel, Ben; Ted Goertzel; eds. (2015): *The end of the beginning: Life, society and economy on the brink of the Singularity.*

114. Some facts on technology (Trevor Kletz, 1996)

"Every error is a human error because: Someone has to decide what to do. Someone has to decide how to do it. Someone has to do it."

- "We cannot have the benefits of modern technology without some disadvantages in terms of pollution and safety."
- "New technologies are usually less hazardous than old ones."
- "The cost of reducing pollution and increasing safety has to be paid for in the end by the public."
- "People, not technology, create hazards and pollution." "To blame pollution on technology is the ultimate dodge of a society unwilling to take the blame for its own errors and stupidity. It is not computers and automation that cause unemployment but the way we use them."

Kletz, Trevor (1996): *Dispelling chemical industry myths*, 3rd edition, CRC Press, Boca Raton, FL.

115. "MYTH M5. The best way of conveying information to people is to tell them." (Trevor Kletz, 1996)

"If we have to convey messages that people want to receive ('where to get free beer,' for example), almost all methods of communication are effective. However, if there is some resistance to the message, as there often is when we are making recommendations to increase safety, for example, then we should choose the most effective method of communication: discussion (...) Discussions take longer than a lecture, but more is remembered and people are more committed to the conclusions because they have not been told what to do but have worked it out for themselves (...) The best size for a discussion group is 12-20. If fewer than 12 are present, the group may not be 'critical' (in the atomic energy sense) and discussion may not take off. If more than 20 are present, the quieter members may not be able to contribute."

116. "MYTH M10. We need to know what is new." (Trevor Kletz, 1996)

"We do need to know what is new, but that should not negate our concern with what is old. In my own area of expertise, namely, loss prevention and process safety, the majority of accidents have well-known causes (...) Spend less time reading magazines that tell what is new and more time reading books that tell what is old. Today, 'old' implies outdated; in the past, it implied something of enduring value; it had to be good to have lasted so long."

117. Views on the future of artificial intelligence

Turner (2019, p. 16) defines artificial intelligence as "the ability of a non-natural entity to make choices by an evaluative process."

- "The optimists emphasise the benefits of AI and downplay any dangers (...) Fundamentally, optimists think humanity can and will overcome any challenges AI poses."
- "The pessimists include Nick Bostrom, whose 'paperclip machine' thought experiment imagines an AI system asked to make paperclips which decides to seize and consume all resources in existence, in its blind adherence to that goal (...) Likewise, Elon Musk has said we risk 'summoning a demon' and called AI "our biggest existential threat'."
- "The pragmatists acknowledge the benefits predicted by the optimists as well as the potential disasters forecast by the pessimists. Pragmatists argue for caution and control."

Turner, Jacob (2019): *Robot rules. Regulating artificial intelligence*, Palgrave Macmillan, Cham, Switzerland.

118. Technological complexity breeds vulnerability

“... we simply have no idea of the huge number of ways that these incredibly complex technologies can go wrong (...) Our technologies—from websites and trading systems to urban infrastructure, scientific models, and even the supply chains and logistics that power large businesses—have become hopelessly interconnected and overcomplicated (...) Computer hardware and software is much more complex than anything that came before it, with millions of lines of computer code in a single program and microchips that are engineered down to a microscopic scale. As computing has become embedded in everything from our automobiles and our telephones to our financial markets, technological complexity has eclipsed our ability to comprehend it.”

“Our technological realm has accelerated the metabolism of the Earth (...) We are of two minds about all this complexity. On the one hand, we built these incredibly complicated systems, and that’s something to be proud of. They might not work as expected all the time, but they are phenomenally intricate edifices. On the other hand, almost everything we do in the technological realm seems to lead us away from elegance and understandability, and toward impenetrable complexity and unexpectedness (...) there are certain trends and forces that overcomplicate our technologies and make them incomprehensible, no matter what we do. These forces mean that we will have more and more days like July 8, 2015, when the systems we think of as reliable come crashing down in inexplicable glitches.”

Arbesman, Samuel (2016): *Overcomplicated. Technology at the limits of comprehension*, Current, New York.

119. The engineers as the heroes of history

“... if there is any one progressive, consistent movement in human history, it is neither political, nor religious, nor aesthetic. Until recent centuries it was not even scientific. It is the growth of technology, under the guidance of the engineers.”

“Technology has progressed continuously from the time of the Agricultural Revolution 10,000 years ago, slowly and hesitantly at first, then with increasing sureness and speed. The sixteenth century marked the beginning of modern engineering because, from that time on, professional societies were formed, treatises on engineering subjects were printed in quantity, engineering schools sprang up, specialization within the profession began, and engineers began to take advantage of the brilliant scientific discoveries of the time. The Industrial Revolution, which started two centuries ago and is still going on, was a surge in the growth of technology. Barring nuclear war, the end of this fruition of engineering is nowhere in sight (...) Today, in technologically advanced lands, men live very similar lives in spite of geographical, religious, and political differences (...) These resemblances are the result of a common technology, and this technology is what many generations of engineers have built up, with the greatest skill and diligence of which human beings are capable, and handed down to us.”

de Camp, L. Sprague (1993): *The ancient engineers*, Barnes & Noble Books.

120. Technological progress as a social struggle

The evolution of technology (which technologies become triumphant) cannot be explained on exclusively technical considerations. Technology can always follow alternative paths and it is social forces that select the path to follow: technologies are involved in a process of elimination of technological designs whose outcome is socially determined (by the struggle between social groups pursuing their interests).

121. On the use of technologies

Once a technological design wins out and is adopted as the standard, the technology maybe used for purposes different from the one motivating the technology. Initially, education and public programming dominated radio broadcasting; similarly, television was originally conceived for surveillance and education. When businesses gained control over the two technologies they transformed them into entertainment media.

Feenberg, Andrew; Norm Friesen (eds) (2012): *(Re)Inventing the Internet. Critical case studies*, Sense Publishers, Rotterdam.

122. The technological bluff (Ellul, 1989)

- **Opposition between people and machines.** People adapt badly to modern techniques: people do not adapt to machines nor machines to people. There is a permanent maladaptation between the social and the technical world. Societies evolve slowly; techniques and machines evolve quickly. Societies rely on the past (habits, traditions, rules, conventions); technologies look at the future.
- **The great technical innovation.** The eventual integration of the social into the technical world, from which a new humanity will emerge.
- **Technolatry.** Ellul views Simon's overoptimistic claims as pseudoscientific absurdities: Simon just projects tendencies (without justifying on which grounds the projection is legitimate) and simply presumes that every discovery/invention will have beneficial effects (masquerading inconvenient phenomena for his theses, like the simultaneity of rural depopulation and urban overpopulation). What is good in a computer virus?
- **Rise of the technocrats.** "The technocrats have a strange blindness to the complex reality of the world and to the lessons of common sense (e.g., that no system can grow indefinitely in a closed and finite universe, a truth that they treat sarcastically). Their great knowledge and narrow specialization prevent them from understanding questions outside their field. Yet they write authoritatively about tomorrow's world (...) They are thus plunged into electronics and computers without a thought that perhaps in the future being able to till a bit of ground or light a wood fire or do proper grooming might be more useful than being able to tap on a keyboard. Such is their casual ignorance of most of what constitutes our world (...) They immediately retort that what opponents want is a return to the Middle Ages. As they see it, there has to be growth. They will not accept any other hypothesis. They find their justification in the fact that increasingly everything depends on the application of techniques. Not only is technique good, not only is it indispensable, but also (...) it alone can also achieve all that human beings have been seeking throughout the centuries: liberty, democracy, justice, happiness (by a high standard of living), reduction of work, etc. "
- **Technology is ambivalent.** Technique and technology are not neutral: they may have good and bad effects. For technological optimists, technology is globally good. Technology's ambivalence is captured by for theses:
 - (1) all technical progress has its price (creation involves destruction, frequently people's lives: no progress is free from shadows);
 - (2) at each stage it raises more and greater problems than it solves (law that problems grow with the growth of techniques);
 - (3) its harmful effects are inseparable from its beneficial effects (cars generate congestion; more and cheaper food available, obesity): favourable effects tend to be apparent in the short-term (and be concrete and clearly identifiable), whereas the negative effects tend to become evident in the long run (and are perhaps diffuse and abstract);
 - (4) apart from the desired and the foreseen, it has a great number of unforeseen effects (surgical interventions replace one infirmity by another; cultivation impoverishes the soil; unexpected harmful effects of DDT; accidents of new technologies).
- **Technology is essentially unpredictable.** Technical change is not teleological: it has no goal. There is no predetermined destination for technical change: it is erratic. Therefore, it is unpredictable (and that makes social evolution also unpredictable).
- **The paradox of Harvey Brooks.** The costs and risk of a new technology are usually assumed by a small fraction of the population, while its advantages tend to be widespread.

123. How deterministic is the history of technology?

Heilbroner (1967) contends that technological development must proceed in a relatively fixed sequence: some developments must necessarily precede others. For instance, societies must pass through the hand-mill before making a transition to the steam-mill, which is necessary to moving to hydroelectric plants; or mastering electricity is necessary before mastering nuclear power.

Heilbroner, Robert L. (1967): "Do machines make history?", *Technology & Culture* 8, 335-345.

124. Evidence for the deterministic view

(1) Examples of simultaneous inventions and discoveries. (2) Absence of technological leaps. Most technological advances seem to be incremental and evolutionary. (3) Predictability of technology. There are two constraints to technological capacity in a given time: the accumulated stock of available knowledge (which only expands gradually) and the level of technical expertise (the material competence). Both determine the ability of industries to produce the equipment corresponding to higher technological levels. That ability also depends on the size of the capital stock. Hence, within certain limits, at least the short- to medium-run evolution of technology appears predictable.

125. Does technology create social orders?

That is, does technology impose social and political traits on societies that adopts the technology? There are at least two elements of influence: the composition of labour force and the hierarchical organization of work.

126. Some questions on technology

What fuels technology? Itself? Is the recent explosive technological development a bubble? Is technology necessarily expansionary? Are there limits for technological expansion? Is technology potentially a *perpetuum mobile*? What are the essential resources for technological growth? Are these resources exhaustible? Can technology's strain of nature reach a limit point? Will technology be the new nature? Could a new nature be technologically built? Are the laws of nature subject to technological manipulation? Can laws of nature be technologically created or modified?

127. Economic revolution by confluence of technologies.

A confluence of technologies will lead to the next production revolution: digital technologies (3D printing, internet of things, advanced robotics), new materials (bio- or nano-based) and new processes (datadriven production, artificial intelligence, synthetic biology).

OECD (2017): *The next production revolution: Implications for governments and business*, OECD Publishing, Paris. <http://dx.doi.org/10.1787/9789264271036-en>

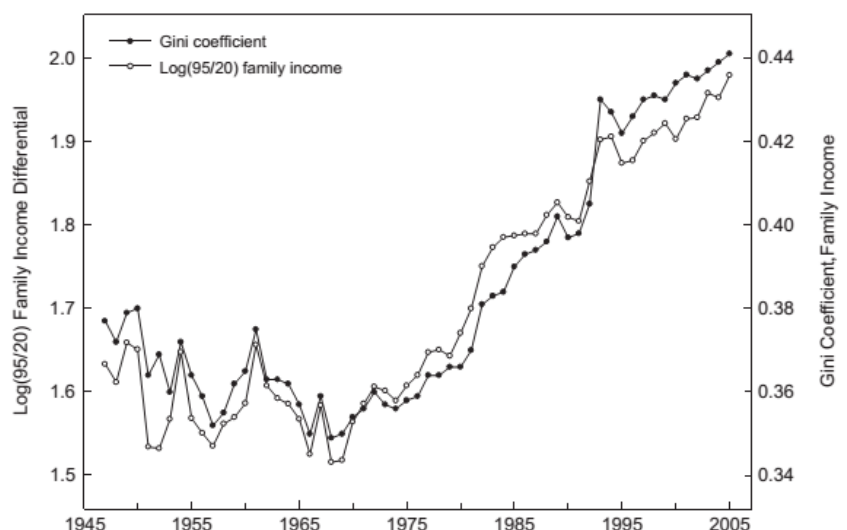
128. Standard view of human capital and development.

At least illustrated by the American experience in the 20th century, given certain institutional preconditions:

↑investment in education → ↑level of technology and productivity → ↑economic growth → ↑standard of living

129. Connection between technological change and inequality through educational progress

Nothing guarantees a fair distribution of the results of economic growth: its benefits may be inequally distributed, so the higher standard of living need not be generally enjoyed. Technological advances tend to increase the demand for more educated (high-skilled) workers, whose earnings would increase in comparison with the earning of the less educated (low-skilled) workers. Economic inequality would then rise if the proportion of the more educated with respect to less educated remains approximately constant (or if the changes in the supply of workers in each category do not offset the changes in the demand for those workers). Hence, technological progress would widen the income gap between more educated and less educated workers (skill-



biased technological progress). Supply side considerations may alter this conclusion: a large increase in the supply of more educated workers could neutralize the increase in earnings of this group relative to the earnings of the less educated group.

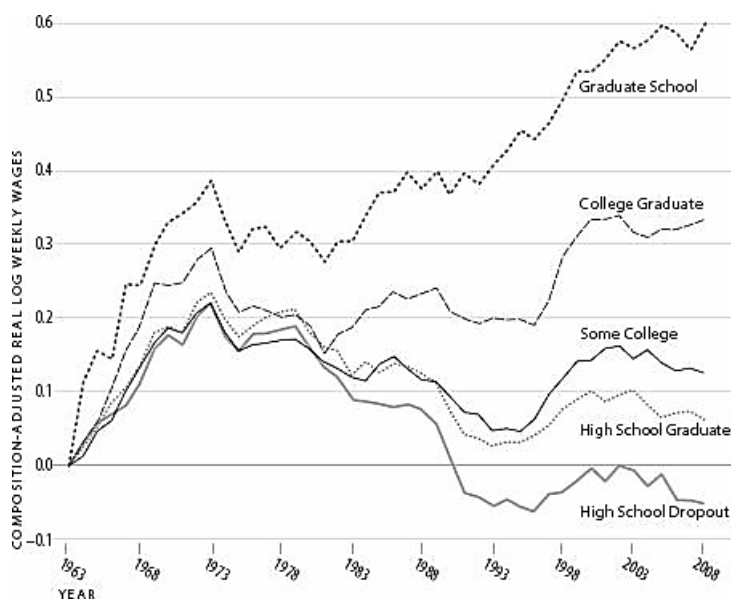
130. Race between technology and education

Apparently, in the US, a rising supply of educated workers (supply of high skills) outstripped the additional demand generated by technological progress: during the first three-quarters of the 20th century higher incomes coincided with a decline in inequality (education raced ahead of technology). In the last two decades, technology raced ahead of education and inequality went up (educational slowdown).

Goldin, Claudia Dale; Lawrence F. Katz (2008):
The race between education and technology,
The Belknap Press of Harvard University
Press, Cambridge, MA.

131. Skill-biased technical change

Digital technologies (big data, high-speed communications) have increased the demand for abstract and data-driven reasoning, and this has risen the value of the workers with the right engineering, creative or design skills. The result is a fall in the demand for less skilled workers and a surge in the demand for the more skilled. The chart on the right shows evidence of the winner-take-all phenomenon: skill-biased



technical change favours people with more human capital (mainly obtained through formal education).

132. Cardwell's law

No country has been at the forefront of technological progress for more than two or three generations. The diversity and multiplicity of players in Europe since the fall of the Roman empire appears to have defined a favourable environment for the replacement of leading or hegemonic countries. The outcome of renewed leadership has been a continuous growth of technology for at least a couple of centuries.

Kindleberger, Charles P. (1996): *World economic primacy, 1500-1990*, Oxford University Press, New York.

133. General approaches to the relationship between technology and society.

- Internalist approach: technology develops in isolation from society.
- Technological determinism: certain inventions or innovations cause major changes in society (social development is related to the development of techniques).
- Dialectical approach: technological and social changes interact mutually.

134. African societies as example of the lack of adoption of superior technologies (resistance to foreign ideas)

Tools from Eurasian preindustrial technology (cart, plow, potter's wheel) were not adopted, despite contact with Eurasia. (2Advanced industrial technology was imported but not successfully integrated with existing locally-based economic structures. African economies remain based on human energy and linear-reciprocal motion (non-human energy sources and technologies based on rotary motion did not spread). Despite exposition to presumably more advanced technologies, material and cultural reasons led to a general rejection of the technologies. The technological gap with Eurasia reinforced rejection: the introduction of

more advanced production technologies in precolonial Africa failed to generate transformations in the rest of the economy (failed to create an economy where those technologies could thrive and develop). The benefits of the new technologies were appropriated by ruling elites, which reinforced their privileged position. Precolonial Africa illustrates the possibility that technology spurs economic growth but not development (innovations can be transferred without the technological capacity embodied in those innovation being simultaneously transferred). Even after 1960, African growth has been characterized by the divergence of African incomes from incomes in other developing regions.

135. Moravec's paradox (paradox of robotic progress)

"The discovery by artificial intelligence and robotics researchers that, contrary to traditional assumptions, high-level reasoning requires very little computation, but low-level sensorimotor skills require enormous computational resources." (Wikipedia). "It is comparatively easy to make computers exhibit adult-level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility." (Hans Moravec)

136. Digitization and overcomplication

One of the most important recent phenomena is that almost everything is being digitized: documents, books, news, statistical information, music, photos, video, maps, social networks, requests for information, responses to those requests, data from sensors, personal information, purchases, services... A by-product of technological progress is that technologies become overcomplicated and more incomprehensible. The current technological level has accelerated the metabolism of the planet, complicating the flow of materials and information.

137. The technological project

Capaldi and Lloyd (2011, pp. xiii-xv) hold that the rise of the technological project in the West (the control and transformation of nature for human benefit) has been the most important development in the last 400 years. They attribute to the technological project: (i) the changes in the mind set, beliefs and institutions in the West; (ii) the expansion of the West to dominate the Rest; (iii) the Industrial Revolution; and (iv) the internationalization of Western institutions ('globalization'). The free market economy is seen as the most effective institution to develop the technological project.

Capaldi, Nicholas; Gordon Lloyd (2011): *The Two Narratives of Political Economy*, Scrivener, Salem, MA and Wiley, Hoboken, NJ.

138. Technological impossibilities

"I divide the things that are 'impossible' into three categories.

The first are what I call *Class I impossibilities*. These are technologies that are impossible today but that do not violate the known laws of physics. So they might be possible in this century, or perhaps the next, in modified form. They include teleportation, antimatter engines, certain forms of telepathy, psychokinesis, and invisibility.

The second category is what I term *Class II impossibilities*. These are technologies that sit at the very edge of our understanding of the physical world. If they are possible at all, they might be realized on a scale of millennia to millions of years in the future. They include time machines, the possibility of hyperspace travel, and travel through wormholes.

The final category is what I call *Class III impossibilities*. These are technologies that violate the known laws of physics. Surprisingly, there are very few such impossible technologies. If they do turn out to be possible, they would represent a fundamental shift in our understanding of physics."

Kaku, Michio (2008): *Physics of the impossible. A scientific exploration into the world of phasers, force fields, teleportation, and time travel*, Doubleday, New York.

139. Technological civilizations (Nikolai Kardashev)

“Russian astrophysicist Nikolai Kardashev has conjectured that the stages in the development of extraterrestrial civilizations in the universe could also be ranked by energy consumption. Using the laws of physics, he grouped the possible civilizations into three types:

1. Type I civilizations: those that harvest planetary power, utilizing all the sunlight that strikes their planet. They can, perhaps, harness the power of volcanoes, manipulate the weather, control earthquakes, and build cities on the ocean. All planetary power is within their control.

2. Type II civilizations: those that can utilize the entire power of their sun, making them 10 billion times more powerful than a Type I civilization. The Federation of Planets in *Star Trek* is a Type II civilization. A Type II civilization, in a sense, is immortal; nothing known to science, such as ice ages, meteor impacts, or even supernovae, can destroy it. (In case their mother star is about to explode, these beings can move to another star system, or perhaps even move their home planet.)

3. Type III civilizations: those that can utilize the power of an entire galaxy. They are 10 billion times more powerful than a Type II civilization. The Borg in *Star Trek*, the Empire in *Star Wars*, and the galactic civilization in Asimov’s Foundation series correspond to a Type III civilization. They have colonized billions of star systems and can exploit the power of the black hole at the center of their galaxy. They freely roam the space lanes of the galaxy.

Kardashev estimated that any civilization growing at a modest rate of a few percent per year in energy consumption will progress rapidly from one type to the next, within a matter of a few thousand years to tens of thousands of years (...) Our own civilization qualifies a Type 0 civilization (i.e., we use dead plants, oil and coal, to fuel our machines). We utilize only a tiny fraction of the sun’s energy that falls on our planet. But already we can see the beginnings of a Type I civilization emerging on the Earth. The Internet is the beginning of a Type I telephone system connecting the entire planet. The beginning of a Type I economy can be seen in the rise of the European Union (...)

The transition between one civilization and the next is far from guaranteed. The most dangerous transition, for example, may be between a Type 0 and a Type I civilization. A Type 0 civilization is still wracked with the sectarianism, fundamentalism, and racism that typified its rise, and it is not clear whether or not these tribal and religious passions will overwhelm the transition. (Perhaps one reason that we don’t see Type I civilizations in the galaxy is because they never made the transition, i.e., they self-destructed).”

“The main danger ants face is not that humans want to invade them or wipe them out. Instead it is simply that we will pave them over because they are in the way. Remember that the distance between a Type III civilization and our own Type 0 civilization is far more vast than the distance between us and the ants, in terms of energy usage.”

Kaku, Michio (2008): *Physics of the impossible. A scientific exploration into the world of phasers, force fields, teleportation, and time travel*, Doubleday, New York.

140. Top 11 trends of 2018 in artificial intelligence (Peter Gentsch, 2018)

“Besides the development towards super intelligence, there are at present a multitude of developments in the field of AI (...) The key trends that have the greatest impact on business are”

- “AI first. Analogue to the ‘mobile first’ mantra, particularly with companies such as Facebook, Microsoft and Google ‘AI first’ prevails: No development without investigating and utilising the AI potentials.”
- “AI will not really become intelligent, yet nevertheless increasingly important for business.”
- “Specific AI systems. The dream of general AI systems independent of functions and sectors has to be dreamed for another whilst (...) In contrast, an increasing number of domain-specific AI systems are being successfully developed and established: Systems for certain functions such as lead prediction in sales, service bots in service or forecasts of validity.”
- “AI inside—embedded AI. AI is being integrated in more and more devices, processes and products.”
- “Democratisation of AI. Despite the immense potential of AI, only a few companies use technologies and methods of AI. This is frequently associated with the lack of access to skills and technologies.”

- “Methodical trend deep learning. Back to the roots—just more massively. Many examples (e.g. the victory over the Korean world champion in Go, sales prediction) impressively show the potential of deep learning (...) Neuronal networks that have been in discussion since the 1950s represent the basis. Thanks to the new IT infrastructures with good performance, these neuronal networks can now be switched in massive parallel.”
- “More autonomy—fewer requirements. Unsupervised and reinforcement learning on the move. Today, a good 80% of all AI applications are based on so-called supervised learning. Training data is required for learning—who are the good guys, who are the bad guys? The algorithm learns discriminating and differentiating patterns.”
- “Conversational Commerce as a driver. Similar to the Internet of Everything, the increasingly important Conversational Commerce will be fuelled by the dramatically increasing number of connected smart devices as well as the necessity and imagination of AI. Conversational Commerce facilitates the optimisation of customer interaction by way of intelligent automation.”
- “AI will save us from the information overkill. There are enough facts and figures about how rapidly the amount of information is increasing dramatically (...) But this is exactly where AI will help by intelligently filtering, analysing, categorising and channelling. NLP (natural language processing) will become more efficient so that speech and text can be increasingly processed automatically.”
- “Besides the business impact of AI, the economic and social change caused by AI is increasingly becoming the topic of conversation. After the megatrends Internet, mobile and the IoT, big data and AI will be seen as the next major trend. The digital revolution is also being called the third industrial revolution.”
- “Blockchain meets AI.”

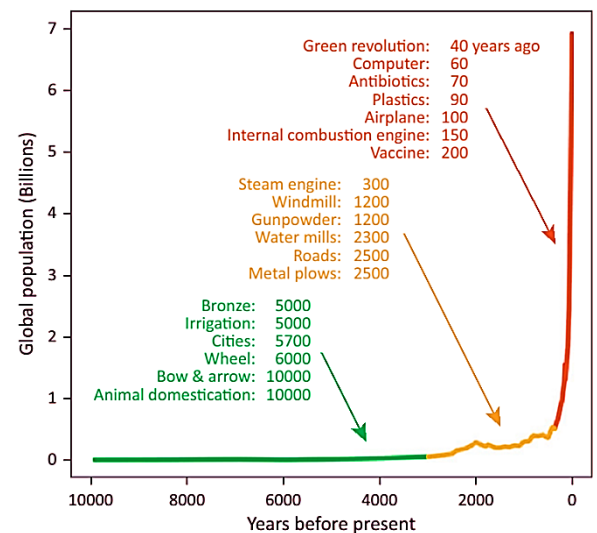
Gentsch, Peter (2019): AI in marketing, sales and service: How marketers without a data science degree can use AI, Big Data and bots, Palgrave Macmillan, Cham, Switzerland.

141. Two social dynamic forces and the sustainable future

“Two interacting forces influence all populations: the Malthusian dynamic of exponential growth until resource limits are reached, and the Darwinian dynamic of innovation and adaptation to circumvent these limits through biological and/or cultural evolution. The Malthusian dynamic pushes a population to increase until it reaches its environmental limits. The Darwinian dynamic pushes against these limits by incorporating new traits and technologies that enhance survival and reproduction. There are restrictions to this Malthusian-Darwinian Dynamic (MDD) (...): it is logically, physically, and biologically impossible for exponential growth to continue indefinitely within a finite world.”

“A central feature of human ecology has been the positive feedback between growth and innovation. As populations grew and aggregated into larger and more complex social groups, more information was acquired and processed. This led to new technologies that further pushed back ecological limits, allowing for continued population growth. The result has been an ascending spiral of exponential processes feeding back on each other: population growth and aggregation begot technological innovation, which in turn allowed for more resource extraction and a greater ability to overcome ecological constraints, begetting still more population growth and socioeconomic development.”

“The ruins of Mohenjo Daro, Mesopotamia, Egypt, Greece, Rome, the Maya, Hohokam, Angkor Wat, and Easter Island are enduring evidence that many earlier societies were unable to innovate their way out of local limits and therefore collapsed despite attaining dense populations and advanced cultures (...) Until now, both Malthusians and Cornucopians have been correct: some populations have crashed and cultures have vanished, but our species has endured because these events have been localized. However, behavioral changes and technological innovations over the last century now intricately interconnect us in a single global society. As a result, local perturbations currently have the ability to reverberate across all of humanity.”



“Within the context of our now highly globalized society, the essential question is how much potential exists for the Darwinian side of the MDD to allow for continued adaptation and innovation to push back against global scale constraints (...) The bad news is that the MDD has left humans ill prepared to make the necessary ecological and behavioral changes required to avoid civilization collapse (...) The good news is that the MDD may also provide valuable insights into potential solutions from both natural (in particular evolutionary biology and ecology) and social (in particular economics and sociology) science perspectives.”

“We must recognize that a sustainable future will ultimately require: (i) negative population growth for a number of generations, followed by zero growth; (ii) a steady-state economy based on sustainable use of renewable energy and material resources; and (iii) new social norms that favor the welfare of the entire global population over that of specific individuals and groups. It is also essential that we recognize that humanity has not yet evolved the genetic or cultural adaptations needed to accomplish these tasks.”

Jeffrey C. Nekola et al. (2013): “The Malthusian-Darwinian dynamic and the trajectory of civilization,” Trends in Ecology and Evolution 1643.

Three Technological Revolutions			
	Agricultural	Industrial	Cybernetic
Origin	Near East, 11,000 years ago	Britain, 1750	United States, 1944
Catalytic Technology	Grain cultivation (wheat)	Steam engine	Computer
Benefits	More food per unit of land; grain storable and tradable	Inexpensive, dependable source of power	Fast, cheap decision making for problems soluble by algorithms
Uses	Feeding people, safeguarding food supply, trading goods (functions like money)	Mechanized pumps, machine powered vehicles, power machinery in factories	Mathematical calculations, processing records, word processing, database management, telephone exchanges, etc.
Effects	Population increase, early cities, roads, shipping, accounting, metal-working, wheeled vehicles, writing, scholarship, science	Factory towns, urbanization, railroads, automobiles, rising living standards, airplanes, surging demand for natural resources—metal ores, coal, petroleum	Faster, cheaper information handling; better management of communications; tighter inventory controls; better distribution of goods; higher standard of living
Workers Displaced	Hunters, gatherers	Farmers, weavers, craftsmen, home workers	Clerks, typists, telephone operators, typesetters, small grocers, middle managers
New Jobs	Early: Farmers, construction workers, carters, brewers, specialized crafts. Later: scribes, scholars	Miners, factory workers, ironworkers, steamship builders, railroaders, steel workers	Computer operators, programmers, repairers, systems analysts, Webmasters, electronic game designers

142. Why cars do not fly, yet?

A thesis and an antithesis by David Graeber (2015, p. 120) and a synthesis by J. S. Mill.

- “There appears to have been a profound shift, beginning in the 1970s, from investment in technologies associated with the possibility of alternative futures to investment technologies that furthered labor discipline and social control.”
- “Yet even those areas of science and technology that did receive massive funding have not seen the breakthroughs originally anticipated.”
- John Stuart Mill: “All the labor-saving machinery that has hitherto been invented has not lessened the toil of a single human being.”

Graeber, David (2015): *The utopia of rules. On technology, stupidity, and the secret joys of bureaucracy*, Melville House, Brooklyn, NY.

143. Tim Hardford’s lessons of the history of technology

- “One: don’t be dazzled by the fancy stuff.”
- “Two: humble inventions can change the world if they’re cheap enough.”
- “Three: always ask, ‘To use this invention well, what else needs to change?’ ”

Hardford, Tim (2018): “What else needs to change?”, Opinion piece, WTO 2018 Trade Report.

144. Lines that the rise of the internet has blurred (John P. Carlin, 2018)

- The line between peace and war (cyberwarfare). “War, over recent decades, has increasingly become the province of lawyers, especially as so many modern adversaries—from al-Qaeda to ISIL—are not clearly defined nation-states. Lawyers review proposed drone and air strikes, sit in the room as covert raids are approved, and provide detailed instructions to officers and soldiers in the field about when they can shoot and when they should hold fire.” “...the internet has delivered nations—and non-nation groups—the ability to engage in actions that appear to step well past the line of peace but fall short of actual war.”
- The line between public and private. “... national defense has been the sole province of the government itself (...) Yet, online, most of the responsibility for protection falls to private companies.”
- The line between nation-state and individual. “Today, weapons of mass destruction can be deployed online by individuals even accidentally—the first ‘internet virus,’ the Morris Worm, was unleashed by a graduate student who didn’t understand the destruction his program would cause. Terror groups, hacktivist groups such as Anonymous, and ‘patriotic hackers’ can today unleash tools and disruptions online that a few decades ago would have been the sole capability of the world’s most powerful nations.”
- The line between physical and virtual. “Cyberspace today includes a complicated set of parts: physical hardware (the computers and infrastructure that run networks), software (the code that runs on computers), and information (the data created and saved inside that software and hardware). Each part impacts the others and would cease to be useful without the full constellation. With today’s technology—and even more so in the future—it’s difficult to tell clearly where the physical world ends and the virtual begins. Money today exists almost entirely virtually, with cash a rarity—and the rise of cryptocurrencies like Bitcoin presage an era when there is no physical money at all.”
- The line between domestic and international. “The internet has allowed instant access to far corners of the globe, allowed people sitting at their desks in one country to chat via video with people a continent away, and given anyone with internet access the ability to reach as many readers or viewers as the New York Times or CNN. This trend has provided all-new challenges to governments and nation-states (...) The person on the other end of a cyberattack could be a teenager down the street, a terrorist overseas, or a military officer in uniform at a desk in an adversary’s capital—and you often don’t know which it is until you’ve solved the case.”
- The line between what is worth and what is not worth protecting. “Our government used to have a very clear understanding of what secrets it was trying to keep (...) it has primarily focused on military secrets, the work of the intelligence agencies, and diplomatic efforts around the globe. Yet we’ve seen in the last decade the weaponization of information in places we never considered a ‘national secret’: the internal communications of a political party, the seemingly boring old personnel records of government employees, the health insurance details of millions of Americans, and, even, the Amazon shopping list of a movie executive.”

“The internet, a tool that was once created to help the US government survive a war, has now become a central point of global tension and a lurking threat to our daily lives.”

Carlin, John P.; Garrett M. Graff (2018): Dawn of the code war. America’s battle against Russia, China, and the rising global cyber threat, PublicAffairs, New York.

145. A grim picture of artificial intelligence (Kai-Fu Lee, 2018)

“When we scan the economic horizon, we see that artificial intelligence promises to produce wealth on a scale never before seen in human history—something that should be a cause for celebration. But if left to its own devices, AI will also produce a global distribution of wealth that is not just more unequal but hopelessly so. AI-poor countries will find themselves unable to get a grip on the ladder of economic development, relegated to permanent subservient status. AI-rich countries will amass great wealth but also witness the widespread monopolization of the economy and a labor market divided into economic castes.

Make no mistake: this is not just the normal churn of capitalism’s creative destruction, a process that has previously helped lead to a new equilibrium of more jobs, higher wages, and a better quality of life for all. The free market is supposed to be self-correcting, but these self-correcting mechanisms break down in an economy driven by artificial intelligence. Low-cost labor provides no edge over machines, and data-driven monopolies are forever self-reinforcing.

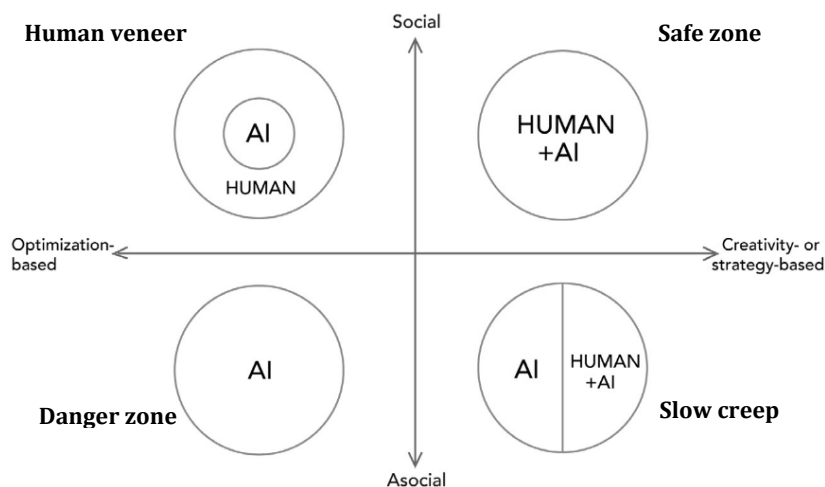
These forces are combining to create a unique historical phenomenon, one that will shake the foundations of our labor markets, economies, and societies. Even if the most dire predictions of job losses don't fully materialize, the social impact of wrenching inequality could be just as traumatic (...) AI risks creating a twenty-first-century caste system, one that divides the population into the AI elite and what historian Yuval N. Harari has crudely called the "useless class," people who can never generate enough economic value to support themselves. Even worse, recent history has shown us just how fragile our political institutions and social fabric can be in the face of intractable inequality."

146. Solutions for AI-induced job losses (Kai-Fu Lee, 2018)

- Retrain workers (skill dimension of the labour market). "Those advocating the retraining of workers tend to believe that AI will slowly shift what skills are in demand, but if workers can adapt their abilities and training, then there will be no decrease in the need for labor."
- Reduce work hours (time dimension of the labour market). "Those advocates of reducing work hours believe that AI will reduce the demand for human labor and feel that this impact could be absorbed by moving to a three- or four-day work week, spreading the jobs that do remain over more workers."
- Redistribute income (compensation dimension of the labour market). "The redistribution camp tends to be the most dire in their predictions of AI-induced job losses. Many of them predict that as AI advances, it will so thoroughly displace or dislodge workers that no amount of training or tweaking hours will be sufficient. Instead, we will have to adopt more radical redistribution schemes to support unemployed workers and spread the wealth created by AI." In the universal basic income proposal the government pays everyone in a country a fixed income stipend. In the guaranteed minimum income proposal only those below a certain income level receive a stipend. "Funding for these programs would come from steep taxes on the winners of the AI revolution: major technology companies; legacy corporations that adapted to leverage AI; and the millionaires, billionaires, and perhaps even trillionaires who cashed in on these companies' success."

147. Human-AI coexistence in the labour market (Kai-Fu Lee, 2018)

"While AI handles the routine optimization tasks, human beings will bring the personal, creative, and compassionate touch. This will involve the redefinition of existing occupations or the creation of entirely new professions in which people team up with machines to deliver services that are both highly efficient and eminently human (...) We expect to see the upper-left quadrant ("Human Veneer") offer the greatest opportunity for human-AI symbiosis: AI will do the analytical thinking, while humans will wrap that analysis in warmth and compassion. In that same chart, the two quadrants on the right-hand side of the graph ("Slow Creep" and "Safe Zone") also provide opportunities for AI tools to enhance creativity or decision-making, though over time, the two left-side AI-centric circles will grow toward the right as AI improves. A clear example of human-AI symbiosis for the upper-left-hand quadrant can be found in the field of medicine."



Lee, Kai-Fu (2018): *AI superpowers. China, Silicon Valley, and the new world order*, Houghton Mifflin Harcourt, Boston.

Lee, Kai-Fu (2018): *AI superpowers. China, Silicon Valley, and the new world order*, Houghton Mifflin Harcourt, Boston.

148. Techno-optimism/transhumanism vs techno-pessimism/primitivism

"As the internet became a mainstream form of communication for millions of people there was a surge of techno-optimism. The early nineties were ablaze with utopian ideas about humanity's imminent leap forward, spurred by connectivity and access to information (...) Many of the net's early advocates believed that, by enabling people to communicate more freely with each other, it would help to end misunderstanding and hatred (...) For every starry-eyed vision of future utopias there was an equally vivid dystopian nightmare (...) Worried by the

proliferation of pornography—including child pornography—and the growing amount of criminal activity taking place online, governments around the world began to pass legislation designed to monitor, control, and censor cyberspace.”

“This divide, between the techno-optimists and the techno-pessimists, is one that stretches back to the birth of the internet, and one that is widening as technology becomes omnipresent, faster, and more powerful. There are, today, two movements that are extreme versions of these opposing views about technology. The transhumanists embrace technology; the anarcho-primitivists reject it. Both groups have existed in some form since the early days of the internet, and both have been steadily growing in popularity (...). Both exist across the dark net (...) But which side is right? Does connectivity bring us together, or supplant real-world relationships? Does access to information makes us more open-minded or committed to our own dogmas? Is there something about the internet, or perhaps technology itself, that shapes and constrains our choices, prodding us to behave in certain ways? And what do their prophetic visions of our technological future—one bright, one bleak—say about the dark net and how we use the internet today?”

“In 2008, the World Transhumanist Association was renamed Humanity+, and remains the largest formal organization of transhumanists, publishing a glossy, quarterly magazine and organizing a number of conferences and academic events (...) Most transhumanist technology focuses on life extension, and technological upgrades to the brain and body.”

[John Zerzan] “is probably the world’s most famous anarcho-primitivist, and the author of several books on why technology—from the internet all the way back to subsistence farming—is at the root of many, if not all, of today’s social problems. He wants to jettison: Facebook, computers, telephones, electricity, steam-powered engines—the lot. Anarcho-primitivism is a branch of anarchist philosophy, which believes in stateless, nonhierarchical, and voluntary forms of human organization, based on simple, precivilization collective living. The most infamous neo-Luddite of modern times was the American Ted Kaczynski, better known as the Unabomber.”

“Instead of looking forward to imagine the future, Zerzan looked back to the past, studying the early Luddite movements, and trade-union groups like the Tolpuddle Martyrs (...) “The introduction of industrial mechanization in the nineteenth century wasn’t just an economic move. It was also a disciplinary move! It was a way to make sure that autonomous people could be controlled by capitalists.”

“Technology is often described as ‘neutral.’ But it could be more accurately described as power and freedom. For the transhumanists, technology provides the ability to stride across the universe, to live forever. For the anarcho-primitivists, it is a tool used to oppress and control others, to become less than human. The dark net is a world of power and freedom: of expression, of creativity, of information, of ideas. Power and freedom endow our creative and our destructive faculties. The dark net magnifies both, making it easier to explore every desire, to act on every dark impulse, to indulge every neurosis (...) Ultimately, the dark net is nothing more than a mirror of society.”

Bartlett, Jamie (2015): *The dark net. Inside the digital underworld*, Melville House, Brooklyn & London.

149. Techno-optimism

“I feel that one of the main reasons people are blind to the dire situation you describe is because of a deep-seated faith in technology. I call this faith ‘techno-optimism’, which can be broadly defined as the belief that science and technology will be able to solve the major social and environmental problems of our times without fundamentally rethinking the structure or goals of our growth-based economies or the nature of Western-style, affluent lifestyles.

What is so seductive about this ‘techno-fix’ approach is that it is politically, economically, and socially palatable. It provides governments, businesses, and individuals with a means of responding to environmental problems (or being seen to respond to environmental problems) without actually confronting the underlying systemic and cultural issues that are driving the crises. Don’t worry, is the message, technology will save us from ourselves.”

Read, Rupert; Samuel Alexander (2019): *This civilisation is finished. Conversations on the end of Empire—and what lies beyond*, Simplicity Institute, Melbourne.

150. Matt Ridley (2010) on the modern global economy

“To explain the modern global economy, then, you have to explain where this perpetual innovation machine came from. What kick-started the increasing returns? They were not planned, directed or ordered: they emerged, evolved, bottom-up, from specialisation and exchange. The accelerated exchange of ideas and people made possible by technology fuelled the accelerating growth of wealth that has characterised the past century.”

“Innovation is like a bush fire that burns brightly for a short time, then dies down before flaring up somewhere else. At 50,000 years ago, the hottest hot-spot was west Asia (ovens, bows-and-arrows), at 10,000 the Fertile Crescent (farming, pottery), at 5,000 Mesopotamia (metal, cities), at 2,000 India (textiles, zero), at 1,000 China (porcelain, printing), at 500 Italy (double-entry book-keeping, Leonardo), at 400 the Low Countries (the Amsterdam Exchange Bank), at 300 France (Canal du Midi), at 200 England (steam), at 100 Germany (fertiliser); at 75 America (mass production), at 50 California (credit card), at 25 Japan (Walkman). No country remains for long the leader in knowledge creation (...) Why must the torch be passed elsewhere at all? (...) The answer lies in two phenomena: institutions and population. In the past, when societies gorged on innovation, they soon allowed their babies to grow too numerous (...) or they allowed their bureaucrats to write too many rules, their chiefs to wage too many wars, or their priests to build too many monasteries (...) or they sank into finance and became parasitic rentiers.”

Ridley, Matt (2010): *The rational optimist. How prosperity evolves*, HarperCollins, New York.

“By far, the greatest danger of Artificial Intelligence is that people conclude too early that they understand it.”

“When you’re building something smarter than you, you have to get it right on the first try.”

—ELIEZER YUDKOWSKY

“AI is likely to be the best or worst thing to happen to humanity.”

—STEPHEN HAWKING

151. The Intelligent Machine Age

“For the first time in human history, we are making machines that will think and evolve without human control. The era of our intellectual superiority is ending. As a species, we need to plan for this paradigm shift. Whether intelligent machines will learn from the darkest parts of our human nature, or the noblest, remains to be seen.”

“The Information Age, sometimes also called the Digital Age, has been incredibly fruitful technologically and beneficial to humankind in many ways. It is also now ending. We are rapidly transitioning to a new age. Whether this new era will one day be called the Experience Age, the Conceptual Age, the Superhuman Age, or something else, this next wave of technological development—from nanotechnology and biotechnology to space exploration and robot avatars—will be brought about not by human inventors alone, but by humans working with a generation of machines exponentially more advanced than anything we have seen before.”

“We are living at the end of the last cycle of technological development led entirely by humans. Artificial intelligence is defining and determining the next era of technology and, thereby, our future.”

“We are merging with our machines, delegating more decision-making to them without acknowledging how much our own cognitive abilities are becoming enmeshed with theirs.”

“... despite a well-intentioned fledgling ‘algorithmic accountability movement,’ we are alarmingly unready for the reality of powerful AI that reaches conclusions and decisions independent from human intervention. Unless we deliberately intervene, AI will not develop an algorithm that values human concerns.”

“Philosopher Nick Bostrom adds that, with respect to developing AI, ‘humans are like small children playing with a bomb.’”

Coleman, Flynn (2019): *A human algorithm. How artificial intelligence is redefining who we are*, Counterpoint, Berkeley, California.

152. AI definitions

“Artificial, machine, digital, synthetic, or virtual ‘intelligence’—AI, broadly speaking—refers to robotics, software, and computers that have the capacity for ‘intelligent behavior.’”

“Generally, it is understood that the ‘reactive’ machines being developed to mimic human behavior that are in use now are known as ‘narrow’ and ‘weak’ forms of AI. By contrast, ‘general’ AIs are those that are able to learn and think for themselves and thus, at least in theory, become intelligent. Artificial general intelligence, ‘strong AI,’ or AGI refers to a machine that has an authentic capacity to ‘think,’ will have at least ‘limited memory,’ and will be capable of performing most human tasks. Artificial superintelligence or ‘ASI’ is a speculative technology that would be self-aware, and some have suggested there should be a fourth category of AI, ‘conscious AI.’”

Coleman, Flynn (2019): A human algorithm. How artificial intelligence is redefining who we are, Counterpoint, Berkeley, California.

153. AI consequences

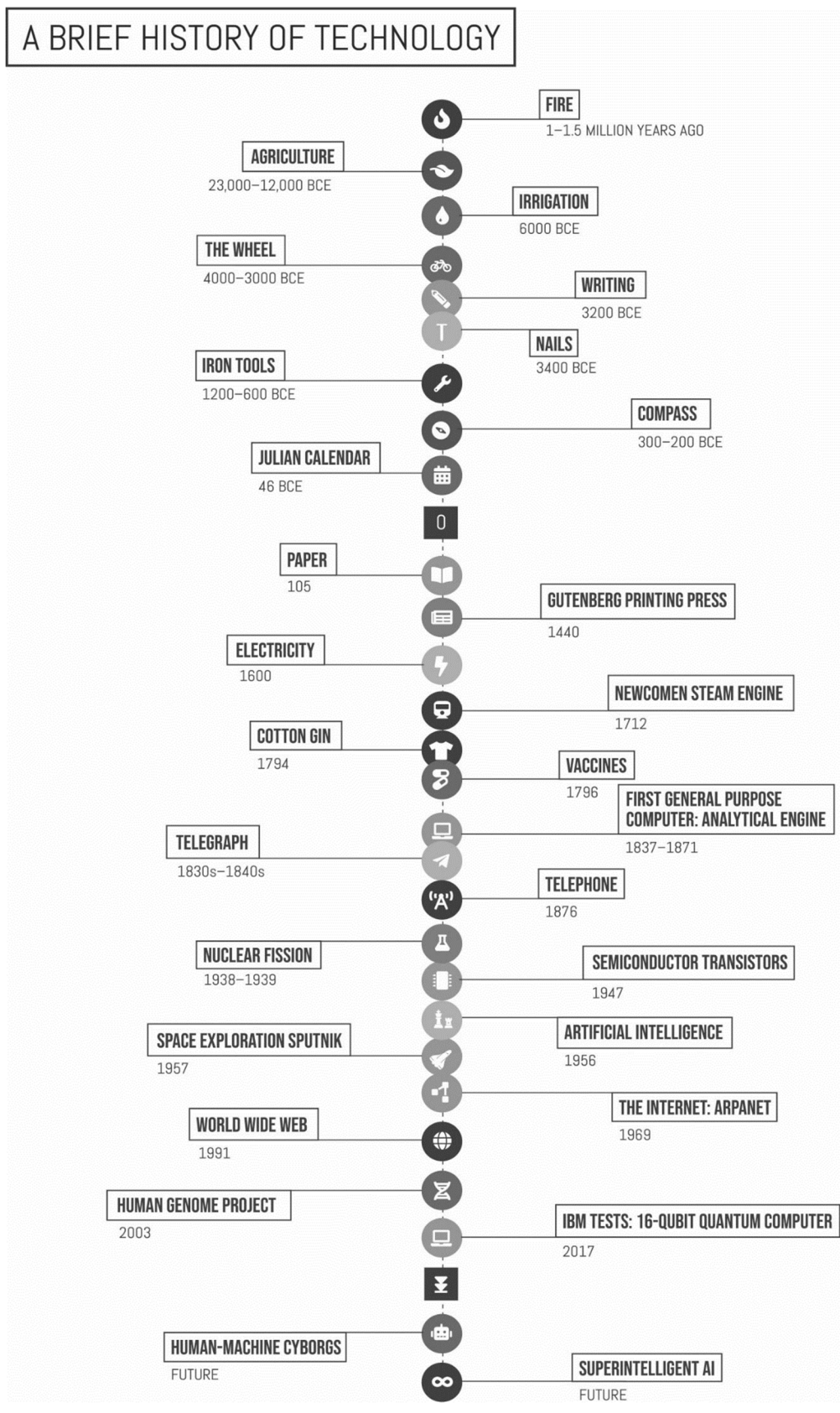
“Automated technology with the capacity to kill humans, such as drones, is already here and in widespread use. The development of fully autonomous killer robots is on the horizon, and cyberwarfare, which includes attacks on information systems, once a fantastical movie plot, is now a growing threat to security.

Another major area where we are already beginning to feel the effects of synthetic intelligence is in the workplace. AI robots are already hard at work across the world. We know that a large percentage of labor will likely be taken over by robots in the coming years.”

“Are we too narrowly focused on the machines’ technology, while overlooking the underlying humanity that needs to be built into them? (...) Amara’s Law, coined by futurist and engineer Roy Amara, describes humans’ proclivity to overestimate the impact of technology in the short term but underestimate its impact in the long term.”

“Are we too narrowly focused on the machines’ technology, while overlooking the underlying humanity that needs to be built into them? (...) Amara’s Law, coined by futurist and engineer Roy Amara, describes humans’ proclivity to overestimate the impact of technology in the short term but underestimate its impact in the long term.”

Coleman, Flynn (2019): A human algorithm. How artificial intelligence is redefining who we are, Counterpoint, Berkeley, California.



154. Trends causing labour abundance (Ryan Avent, 2016)

- Automation. “New technologies are replacing certain workers, from clerks to welders, and will replace more in the future, from drivers to paralegals. Machines are becoming defter and software is becoming cleverer, and these improvements are increasing the set of human tasks that can be cheaply automated.”
- Globalization. “It would have been nearly impossible for rich Western firms to manage the sprawling global supply chains that wrapped around the world over the last twenty years without powerful information technology (...) Global employment grew by over one billion jobs over the last generation, with most of the growth occurring in emerging economies. Workers there are, on the whole, less skilled than those in the rich world, and their incorporation into the global economy has been felt more keenly by workers in middle-skill manufacturing or back-office jobs than by white-collar professionals. That need not last; the developing world is home to millions of engineers, doctors, financial professionals and others who are just as capable of serving clients as their peers in America and Europe.”
- Rising productivity of some highly skilled workers. “...technology provides a massive boost to the productivity of some highly skilled workers, allowing them to do work which it might previously have taken many more people to accomplish. Technology enables small teams of money managers to run vast funds; it is increasingly allowing highly skilled instructors to build courses that can be taken and re-taken by millions of students, potentially replacing hundreds or even thousands of lecturers. New technology is allowing fewer doctors and nurses to observe and treat manymore patients, fewer lawyers to pour through vastly more trial-related evidence, and fewer researchers to sift through massive amounts of data and test more hypotheses more quickly.”

155. Adjustments to labour abundance

“The economy, and society, will try to adjust. That adjustment will mean stagnating wages for many workers, rising inequality, and a tenuous and fading connection to the world of work for many others. Workers are unlikely to take these woes lying down. Something has to give. Either society will find ways to shore up work or develop substitutes for it, or workers will use the political system to undermine the forces disrupting their world.”

“What is missing from the conversation is a clear explanation of how rapid technological change is compatible with both rising employment globally and disappointing growth in wages and productivity. And while it may be correct (...) that a world of technological prosperity and plenty awaits us in the distant future, it is wrong (...) to characterize the digital revolution as something entirely different from anything that has come before (...) The digital revolution is very much like the industrial revolution. And the experience of the industrial revolution tells us that society must go through a period of wrenching political change before it can agree on a broadly acceptable social system for sharing the fruits of this new technological world.”

“It is unfortunate, but those groups that benefit most from the changing economy tend not to willingly share their riches; social change occurs when losing groups find ways to wield social and political power, to demand a better share. The question we ought to be worried about now is not simply what policies need to be adopted to make life better in this technological future, but how to manage the fierce social battle, only just beginning, that will determine who gets what and by what mechanism.”

“A makers-and-takers conception of the world is one that neglects the social foundation on which wealth is built. We aren’t merely divided into makers and takers. We are participants in societies, operating according to a broad social consensus. When that consensus breaks down, the wealth goes away. Society either agrees a way to share its riches that most members find acceptable, or the system fractures and the social wealth available to everyone shrinks.”

“Wealth has always been social (...) Wealth creation in rich economies is nurtured by a complex system of legal institutions (such as property rights and the courts that uphold them), economic networks (such as fast and efficient transportation and access to scientific communities and capital markets) and culture (such as conceptions of the ‘good life’, respect for the law, and the status accorded to those who work hard and become rich). No individual can take credit for this system; it was built and is maintained by society. The digital revolution is increasing the importance of social wealth.”

“... these two kinds of conflict –between individuals and society, and between society’s insiders and outsiders– create the fundamental tension presented by the digital revolution. To take full advantage of its promise, countries must become better at sharing social wealth. Yet the better countries become at sharing social wealth among members, the greater the pressure to shrink the circle of social membership.”

Avent, Ryan (2016): *The wealth of humans: Work, power and status in the twenty-first century*, St. Martin’s Press.

The essence of innovation, p. 105

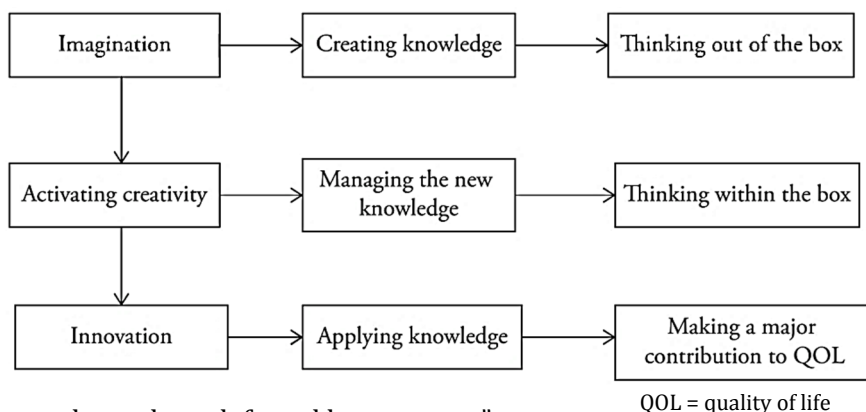
156. Innovation is the answer (A. Coskun Samli, 2014)

“Innovation is simply not emphasized. Since the private sector is experiencing record levels of profit, the stock market is breaking records, but the sluggish economy is crawling because there is not enough motivation for the private sector to put major resources into innovation. And the opposition is blocking the government from engaging in such necessary activities. Thus, one of my pet ideas, that is, generating a culture of innovation is not dormant, it is almost nonexistent. Once again, a most progressive and dynamic society such as ours is blocked by ignorance and unnecessary conservatism.”

“The market system cannot be utilized fully without major innovational activity. Ignorance and greed are blocking such an activity.

Rectifying this situation can only be achieved by creating a drive to innovate (...) It is extremely critical that firms, hopefully all firms, have certain futuristic ambitions that would, at least partially, deal with innovation. An economic system that is not ambitious enough to innovate is not likely to make progress. Thus, innovation is the answer to major economic doldrums. The vehicle of the market system is simply waiting for positive movement, which will come only when ignorance and greed are defeated by progress.”

The Necessary Conditions	Implications
Curiosity cultivation	Serious challenges for curiosity to explore
Knowledge base development	There are enough educated people to innovate
Identifying the desired future	Having mature and ambitious future plans
Keeping a constant state of progress	Understanding the dynamic nature and progress of markets
Making radicalism a common concept	Cultivating radical thinking and applications
Generating the necessary talent	Talent can be cultivated by education and motivation
Creating a futuristic orientation	Not being satisfied with present conditions and always looking for improvement
Balancing basic versus applied research	Not only researching for current problems but also for future explorations
Putting special emphasis on radical innovations	Understanding the major innovational progress generated by radicalism



The workings of an innovative culture, p. 98

157. A technological paradox

“In a laissez faire capitalist economy, the choice boils down to two perspectives: 1) if one introduces policies to safeguard the standard of living of workers by establishing that the minimum wage cannot fall below a certain threshold (moderate left policy), the system produces ‘technological unemployment.’ 2) if it is established that the government must not interfere in negotiations between capitalists and workers, letting the market decide wage levels (moderate right policy), the system produces ‘technological impoverishment.’ All this happens when an impressive technological development may *potentially* improve the life condition of everybody. Thus, contemporary society seems to be inherently characterized by a ‘technological paradox.’”

Campa, Riccardo (2018): *Still think robots can’t do your job. Essays on automation and technological unemployment*, D Editore, Rome.

158. Fixation on efficiency and future of work

“In the industrial age (...) growing efficiencies increased prosperity, reduced poverty, and stabilized democracy. Enhanced productivity contributed to the rise of the American middle class. But in the digital age, this logic is

flawed. Our sometimes unquestioning pursuit of efficiency has led us to underrate the importance of quality, of both work and life. It has led us to judge farmers not by the nutritive value or taste of their produce but by its price; doctors not by the lives they save and better but on the number of patients they treat; teachers not by the students they enlighten and inspire but by the test scores those students generate. It has led us to overvalue certain sorts of work and undervalue other sorts, driving many of us *...(to pursue jobs that hold little meaning for ourselves and only questionable value for society. Our fixation on efficiency has led us to generate more goods and services that we may desire but don't need and not enough goods and services that we both desire and desperately need. Another troubling trend is that as workers we no longer profit proportionally from our efforts: since 1973 our productivity has grown almost six times faster than has our wages."

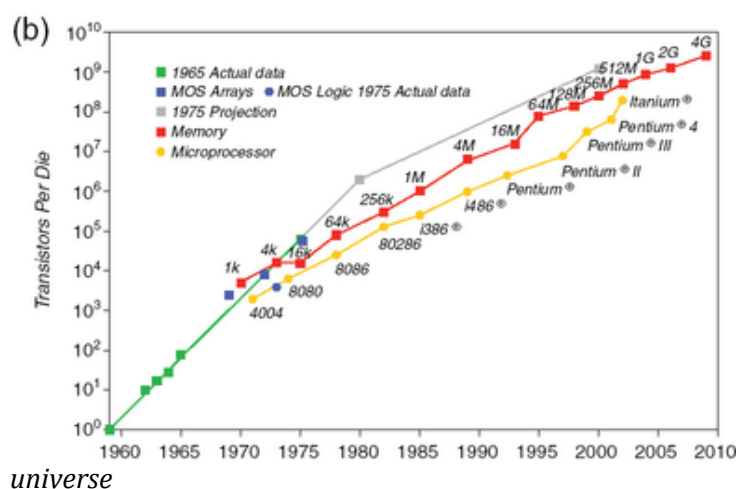
"America was built on an economic platform by which citizens earn their income—and their sense of worth—through employment. That strategy has served us well. But in an age when so many able-bodied adults lack full-time, stable employment, it is not enough. Our challenge is not finding more ways to fit people into 'meaningful' jobs. Our challenge is helping people find and sustain work that offers them an opportunity to make a contribution, to make them feel worthwhile, and to make meaning for themselves. Growing efficiencies was a fixation of the industrial age. It's a fixation we can no longer afford. We must quell the GDP fetish (...) The future of work depends less on our digital creations than on our collective imagination (...)the very technology disrupting so many forms of work today could be used to enable a new model by which compensation is based at least in part on an individual's 'social contribution.'"

Shell, Ellen Ruppel (2018): *The job. The future of work in the modern era*, Currency, New York.

159. Pernicious effects of offshoring (Stephen Slavin, 2017)

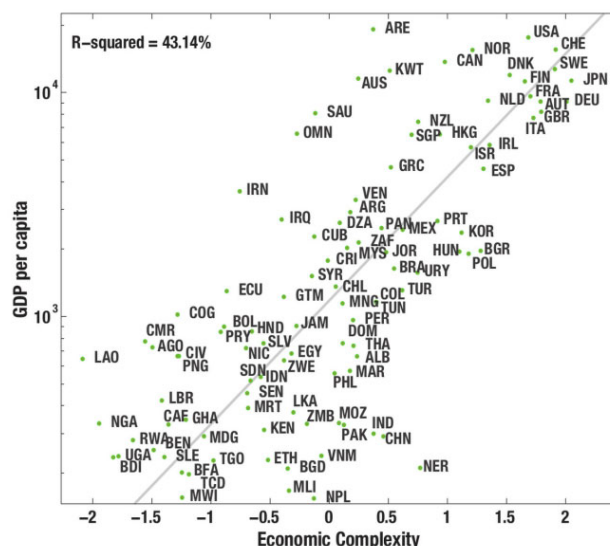
Apparent effects of globalization on the US economy it at least two ways: American industrial power has fallen (the US is no longer the world's leading manufacturing power it was for a century: it is China since 2010) and a sizeable amount of domestic operations have shifted abroad (offshoring).

- "Offshoring manufacturing jobs (...) Capital and technology have been shifting from the older and richer industrial nations to the newly industrializing nations where highly skilled, educated, and motivated workers are willing to work for a dollar an hour. Multinational corporations, driven by fierce competition, must operate in low-wage nations or be forced out of business.
- Offshoring and wages: How has the offshoring of millions of manufacturing jobs affected the hourly wage rates paid on the remaining jobs? Those who lost their jobs competed for other jobs, tending to bid down wage rates. Since 1973, the (inflation adjusted) hourly wage rate paid to nonmanagerial workers—80 percent of our labor force—has remained about the same. Employers often succeed in holding down wage rates by threatening to move their businesses to low-wage countries."



universe

"Moore's law still working after nearly fifty years"
Hey, Tony; Gyuri Pápay (2015): *The computing*



160. Technology: strive for control

“Let me begin by stating the obvious: We live in an era of technological enthusiasm. It’s not too vast a generalization to say that Americans, along with much of the world, are deeply, passionately in love with the technologies they use in their personal lives. We’re also beguiled by the promises of scientists and engineers who say that, thanks to them, we’ll soon be able to do just about anything we want to do. ‘At our current rate of technological growth,’ said Elon Musk, CEO of Tesla Motors and SpaceX, ‘humanity is on a path to be godlike in its capabilities.’ (...) Such comments also testify to a more recent wrinkle in utopian visions: that new technologies will be able to remedy the problems created by previous technologies. We see the same faith at work in the conviction of those who believe we’ll come up with some way of reversing the catastrophe of global warming by ‘geoengineering’ the climate of the entire planet.”

“Four basic, overlapping characteristics or sets of characteristics can be cited as fundamental elements of the nature of technology. They are (1) Technology is by nature expansive. (2) Technology is by nature rational, direct, and aggressive. (3) Technology by its nature combines or converges with other technologies. (4) Technology by its nature strives for control (...) The four characteristics (...) point to the central question of whether technology at some point becomes autonomous— that is, does technology at an advanced stage of development become impossible for human beings to control?”

“If there is a single lesson (...) that I could drum into the mind of every technician on the planet, it would be the certainty of uncertainty. For despite their willingness to acknowledge uncertainty on the micro level and to use it to improve performance, technophiles consistently evince a depressingly broad degree of myopia in regard to uncertainty on the macro level. In other words, scientists and engineers will focus intently on the inconsistencies that appear within their specific projects and work diligently to get rid of them. At the same time they’ll be perfectly willing to overlook the unpredictable results of their projects’ interactions with other, supposedly unrelated technologies in the world at large. In doing so they ignore two (...) principles:

1. There are no unrelated technologies.

2. The more powerful a given technology, the more widely its effects will radiate outward, the more difficult it will be to predict those effects, and the more damaging those effects can potentially be (...) The effects of powerful technologies radiate outward, producing in the process consequences that are both unintended and unexpected, often at velocities that exceed our ability to stop or contain them.”

“Technology doesn’t fix technology, technology *demand*s technology. Given that we seem unable to make even minor sacrifices of consumption and convenience, we probably have no choice but to stay, in some fashion, the technological course (...) The societies we’ve constructed are so utterly dependent on our machines that any attempt to abruptly disconnect would be spectacularly, fatally disruptive. Unless and until we find a way to reposition ourselves in relation to nature, we’re pretty much stuck.”

“It’s a truism that power corrupts, and at its most fundamental level technology is about power. It follows that arrogance and overconfidence may be natural by-products of technological power.”

“[Norbert Wiener] said that the only true security comes from ‘humility and restrained ambitions’ (...) Technology is a two-edged sword, he said, ‘and sooner or later it will cut you deep’.”

“I see no harm in mentioning two general suggestions that would, if widely and comprehensively pursued, move us in a positive direction. The first of these is restraint. Cut back, on everything (...) My second suggestion is (...) pay some attention to redressing the imbalance, in the culture in general and in education in particular, between means and ends.”

Hill, Doug (2016): *Not so fast. Thinking twice about technology*, University of Georgia Press, Athens, Georgia.

161. Some ‘laws,’ rules and principles

Arthur C. Clarke's laws of prediction

- First law. “When a distinguished but elderly scientist states that something is possible, he is almost certainly right. When he states that something is impossible, he is very probably wrong.”
- Second law. “The only way of discovering the limits of the possible is to venture a little way past them into the impossible.”
- Third law. “Any sufficiently advanced technology is indistinguishable from magic.”

Variation on Clarke's third by Mark Stanley (Freefall)

- "Any technology, regardless of how advanced, will seem like magic to those who do not understand it."

Melvin Kranzberg's six laws of technology (the sixth omitted)

- First law. "Technology is neither good nor bad; nor is it neutral."
- Second law. "Invention is the mother of necessity."
- Third law. "Technology comes in packages, big and small."
- Fourth law. "Although technology might be a prime element in many public issues, nontechnical factors take precedence in technology-policy decisions."
- Fifth law. "All history is relevant, but the history of technology is the most relevant."

Hofstadter's law

- "It always takes longer than you expect, even when you take into account Hofstadter's Law."

The freedom-security dilemma

- "The product of Freedom and Security is a constant."

Technology remakes both the physical and the mental worlds

- "Ethics change with technology."

Amara's law (Roy Charles Amara, 1925-2007)

- "We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run."

Goodhart's law (Charles Goodhart)

- "When a measure becomes a target, it ceases to be a good measure." (When you close the door, expect people to open a window.)

Hutber's law (Patrick Hutber)

- "Improvement means deterioration." (Anything presented as an improvement hides a deterioration.)

Orgel's second rule (Leslie Orgel)

- "Evolution is cleverer than you are."

Pareto rule (Vilfredo Pareto)

- "80% of the output/consequences tends to be accounted by 20% of the inputs/causes."

Peter principle (Laurence J. Peter)

- "In a hierarchy, every employee tends to rise to his level of incompetence."

Shirky principle (Clay Shirky)

- "Institutions will try to preserve the problem to which they are the solution."

Sturgeon's law (Robert Sturgeon)

- "Ninety percent of everything is crud."

The invisible law of market stupidity

- "The market is more stupid than everybody thinks."

Cipolla's basic laws of human stupidity (Carlo Maria Cipolla)

- First law. "Always and inevitably everyone underestimates the number of stupid individuals in circulation."
- Second law. "The probability that a certain person be stupid is independent of any other characteristic of that person."
- Third law. "A stupid person is a person who causes losses to another person or to a group of persons while himself deriving no gain and even possibly incurring losses."

- Fourth law. “Non-stupid people always underestimate the damaging power of stupid individuals. In particular non-stupid people constantly forget that at all times and places and under any circumstances to deal and/or associate with stupid people infallibly turns out to be a costly mistake.”
- Fifth law. “A stupid person is the most dangerous type of person.”

Hanlon's razor (Robert J. Hanlon)

- “Never attribute to malice that which is adequately explained by stupidity.”

The expert law of expertise

- “For every expert, there is an equal and opposite expert.”

Serge Lang's laws of sociodynamics (Lang, Serge (1998): *Challenges*, Springer, New York, p. 797)

- First law. “(a) The power structure does what they want, when they want; then they try to find reasons to justify it. (b) If this does not work, they do what they want, when they want, and then they stonewall.”
- Second law. “An establishment will close ranks behind a member until a point is reached when closing ranks is about to bring down the entire establishment; then the establishment will jettison that member with the least action it deems necessary to preserve the establishment.”
- Third law. “It's like the video games: one can't shoot fast enough.”

Murphy's laws (Koch, Richard (2013): *The 80-20 Principle and 92 Other Power Laws of Nature*)

- “Left to themselves, things go from bad to worse.”
- “If anything can go wrong, it will.”
- “If several things can go wrong, the one that will cause the most damage will go wrong first.”
- “If anything just cannot go wrong, it will anyway.”
- “The probability of anything happening is proportional to the damage it will cause.”

The Dilbert principle (Scott Adams)

- “Leadership is nature's way of removing morons from the productive flow.”

Sunday February 05, 1995



<http://dilbert.com/strip/1995-02-05>

The Dunning-Kruger effect (David Dunning and Justin Kruger)

- “People tend to regard themselves as more competent or capable than they actually are.”

The social entropy principle

- “If something seems to go well, it is because someone is bearing the cost of the good performance (without enjoying much of the benefit).”

The Red Queen effect

- “Constant effort is required to just maintain success.” (The natural condition of the social world is entropy growth, not equilibrium.)

162. The devilish dilemma of Big Data (Klous and Wielaard, 2016, p. 40)

“Many Big Data plans face a major dilemma. Companies need more and more data in order to create (social) value to provide the services we require. The more we are willing to share that data, the more they are capable of meeting our needs and thereby creating social value. But many people are strongly against sharing more data. They associate Big Data with Big Brother scenarios, and are worried that companies only want to make as much money as possible from our personal data and that governments don’t care about our privacy.”

Klous, Sander; Nart Wielaard (2016): *We are Big Data. The future of the information society*, Atlantis Press.

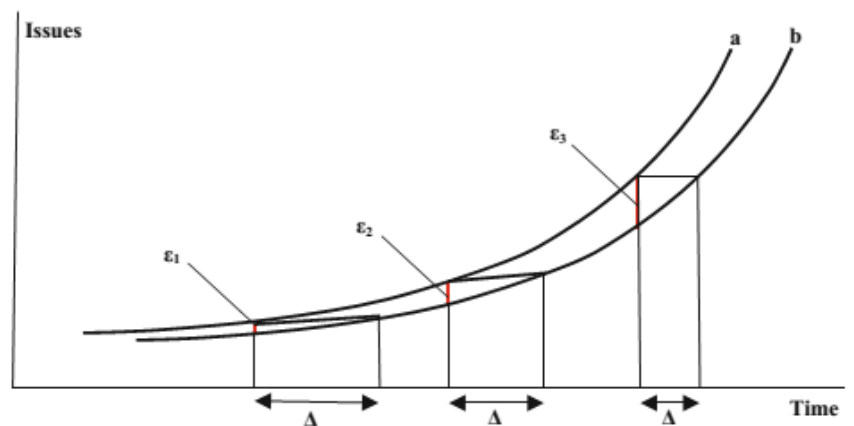
163. Jevons paradox (William Stanley Jevons, 1865)

“It is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to a diminished consumption. The very contrary is the truth.”

- All efforts to maintain the resource and energy base of an economy are eventually futile. Specifically, technological improvements that improve the efficiency of resources or sources of energy lead to an increase (not a decrease) in the consumption of the resources or the energy sources (coal, oil, electricity...). Since technological improvements make the use of resources cheaper, more of the resources will be used.
- If a new technology reduces the amount of a certain resource (and the environmental impact) per unit of production, the new technology may have an expansionary effect on the general economic activity that could increase the amount actually used of the resource and its environmental impact. The paradox is that a technology created to save resources and the environment may ultimately offset the initial energy/environmental savings and contribute to worsen the original problems: resource depletion and environmental deterioration. The underlying explanation is that technologies are not developed and adopted to achieve social goals, like saving resources or the environment, but to make (private) profits.

164. Issues created by technology

Curve **a** represents, as a function of time, the issues (social, political, cultural, economic problems) created by new technologies. Curve **b** shows the issues that are resolved. The vertical distance between the two curves at any point in time measures the number of issues pending of resolution. The figure indicates that this number is increasing: new technologies are introduced at a faster rate than society solves the issues. Slow or inadequate response to technological change may destabilize or collapse society, overburdened by issues pending of resolution.



Mayer, Maximilian (ed) (2018): *Rethinking the Silk Road. China’s Belt and Road Initiative and emerging Eurasian relations*, Palgrave, Macmillan, Singapore.

165. Kitty Hawk moment

“Artificial intelligence is having its Kitty Hawk moment. For decades, the pioneers of aviation promised grandiose feats, only to fall short again and again. But then the Wright brothers had a breakthrough—their first flight in Kitty Hawk, North Carolina, in 1903—and the technology took off. Suddenly, what had for years been nothing but a boastful claim now worked. And so it is for AI: After many years of relatively slow, underwhelming progress, the technology is finally starting to perform, and now a cascade of breakthroughs are flooding the market, with many more in the works. Computer programs’ ability to recognize human faces has recently surpassed our own.

Google Assistant can mimic a human voice and set a haircut appointment with such perfection that the person on the other end of the line has no idea they are talking to a data-rich IT system. In identifying certain cancer cells, computers today are already more accurate than the best doctors in the world—to say nothing of average doctors working in mediocre hospitals. Computers can now beat us at the nearinfinitely complex board game Go, and if that weren't enough, they've also become better bluffers than the best poker players in the world."

"By twenty years after the first powered flight at Kitty Hawk, a new industry had arisen. Soon after that, air travel fundamentally changed the world. Artificial intelligence might follow a similar course. As soon as computer programs that learn from data prove themselves more efficient at a job than people are, their dominance of that industry will be inevitable. When built into physical machines like cars, robots, and drones, they take older automation processes in the material world to the next level. Networked together, they become an internet of intelligent things capable of cooperating with each other."

"Euphoric utopians in Silicon Valley like the author and Google researcher Ray Kurzweil see in this the key to solving all the major problems of our time, when a wish-granting artificial general intelligence (AGI) will make our lives easier, and maybe even eternal—in the form of an upload to the cloud (...). Apocalypticists, who—like the Oxford philosopher Nick Bostrom—are often European, fear the seizure of power by superintelligent machines and the end of humanity."

Range, Thomas (2019): *Who's afraid of AI? Fear and promise in the age of thinking machines, The Experiment, NY.*

166. Adversarial input

"In the domain of image processing, the concept of adversarial input has been likened to creating optical illusions to which only AI is susceptible. An adversarial image might be generated by sprinkling seemingly unimportant pixels across an image of a cat that causes the AI to classify the image as a dog, without introducing any noticeable features that a person would discern as dog-like. Adversarial input could also be some marks on a road sign that we would interpret as graffiti, but which could cause an autonomous vehicle to misinterpret the sign."

Warr, Katy (2019): *Strengthening deep neural networks. Making AI less susceptible to adversarial trickery, O'Reilly, Sebastopol, CA.*

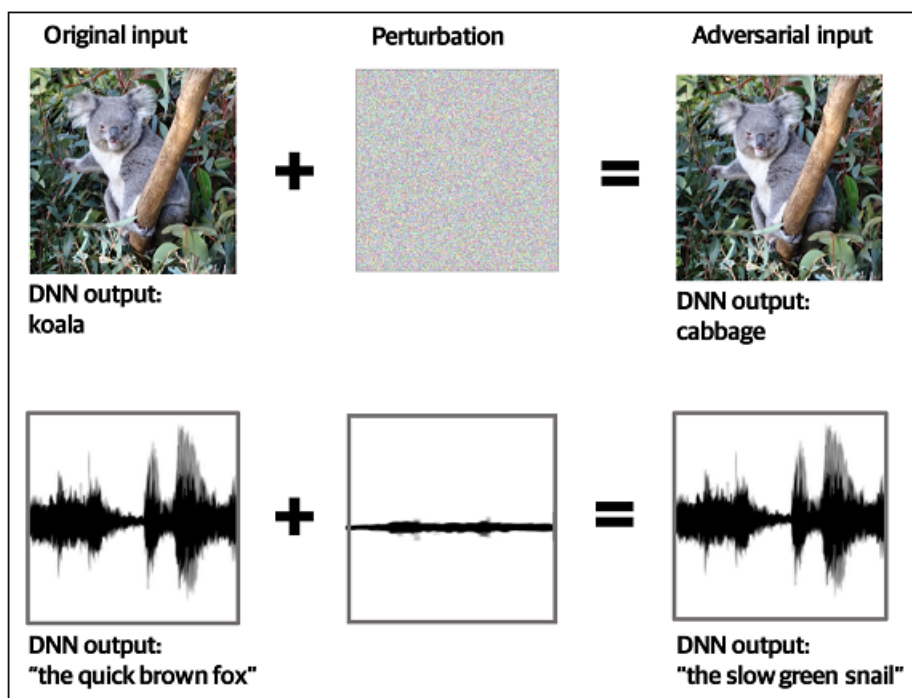


Figure 1-3. Adversarial perturbation applied across an image to fool an image classifier and across audio to fool a speech-to-text system

167. The Technological Singularity Hypothesis

"The technological Singularity hypothesis stipulates that humans will create machines that have more cognitive ability than humans do. In turn, these machines will be capable of creating even more advanced intelligent machines than themselves. In quick succession, there will be an explosive growth in artificial intelligence resulting in machines with exponentially more knowledge and problem-solving capability than human beings. If the technological Singularity hypothesis is true, this future world is not millennia or centuries away; it will arrive in the coming decades and forever alter the course of humanity in ways that are unpredictable."

"The technological Singularity will usher in a number of risks and crises for humanity. The Singularity will constitute an economic risk to humanity. As machines begin to surpass human capabilities in every realm, it will be an economic advantage for corporations to use machines rather than humans in every task. We will

experience massive unemployment at the same time as our economies exhibit enormous growth in productivity. Enormous wealth will be created, but the distribution of this wealth is likely to be highly unequal.”

“The Singularity will produce an existential risk to humanity. A superintelligence may develop its own motivations and goals that may be in conflict with humankind’s motivations and goals. With its superior intellect and capabilities, it will be able to outthink, outplan, and outwork us. Humans may become irrelevant to a superintelligence’s goals, and, worse, humans may be considered an impediment to those goals. What steps can be taken to prevent such an outcome?”

Guinn, Curry I. (2019): ‘Runaway AI’, chapter 10 in *Savage ecology. War and geopolitics at the end of the world*, Duke University Press, Durham and London.

168. The paper clip factory example: how to achieve a moral AI?

“Bostrom (*Superintelligence. Paths, dangers, strategies*, 2014) uses the example of a paper clip factory to illustrate how a seemingly benign end goal, maximizing the number of paper clips produced, could have catastrophic results. To maximize the number of paper clips, the intelligent machine would have several subgoals. One of those subgoals is to become more intelligent, because the more intelligent it is, the better it can be in maximizing the production of paper clips. (In fact, the goal of becoming more intelligent would be a subgoal of any intelligent agent for similar reasons.) As it innovates and develops, it would become more efficient at converting matter into paper clips until all the matter on Earth, in the solar system, and in the Milky Way and beyond is converted into paper clips. This example is intentionally absurd for a reason: it illustrates how a superintelligence’s relentless pursuit of a goal could clash with human values. How do we endow these synthetic intelligences with a sense of morality or ethics that correspond to human values?”

Guinn, Curry I. (2019): ‘Runaway AI’, chapter 10 in *Savage ecology. War and geopolitics at the end of the world*, Duke University Press, Durham and London.

169. The cooperation problem is not about technology

“Humans now have the power to destroy planet Earth, and we seem to be headed that way. It’s puzzling, though. We have the technological prowess to give up fossil fuels, stop polluting, feed everyone alive, bring our runaway population growth under control—we could solve all the problems facing our species if only we could all sign onto a single plan of action. Why is that so hard? Why is it so hard for us to operate as a single, integrated human community, given that anyone can now communicate instantly with anyone else?”

To my mind, the answer is clear: anyone with anyone is not the same as everyone with everyone. Technology can give us anyone with anyone, but everyone with everyone is a different kind of problem. We have trouble making decisions as one whole species because we live in a great many different worlds of meaning, and that’s a problem that exists in the realm of language, not technology. Everyone is part of some intercommunicative zone, some far-flung network of people who are interacting more prolifically with one another than with others. In recycling our stories and reports among ourselves, within our zone, we build a picture of reality that all of us who are creating it can see. The big picture we share makes us intelligible to one another, thereby empowering us to operate as a social constellation, but it makes us less intelligible to people outside our narrative. As the novelist Yann Martell once said, ‘We are all citizens of the languages we speak, and World is not a language.’”

Ansary, Tamim (2019): *The invention of yesterday. A 50,000-year history of human culture, conflict, and connection*, PublicAffairs, New York.

170. The Assassination Market

“There are four simple instructions listed on its front page:

- >Add a name to the list
- >Add money to the pot in the person’s name
- >Predict when that person will die
- >Correct predictions get the pot

“The Assassination Market can’t be found with a Google search. It sits on a hidden, encrypted part of the internet that, until recently, could only be accessed with a browser called The Onion Router, or Tor (...) Tor works by repeatedly encrypting computer activity and routing it via several network nodes, or ‘onion routers,’ in so doing concealing the origin, destination, and content of the activity. Users of Tor are untraceable, as are the websites, forums, and blogs that exist as Tor Hidden Services, which use the same traffic encryption system to cloak their location (...) The Assassination Market has a fifth instruction:

>Making your prediction come true is entirely optional.”

“The Assassination Market is a radical example of what people do online when under the cover of real or perceived anonymity.”

“The dark net, for me, describes an idea more than a particular place: internet underworlds set apart yet connected to the internet we inhabit, worlds of freedom and anonymity, where users say and do what they like, often uncensored, unregulated, and outside of society’s norms (...) The same anonymity that allows the Assassination Market to operate also keeps whistleblowers, human-rights campaigners, and activists alive.”

“[Jim] Bell hoped the very existence of this market would mean no one would dare throw their hat into the ring at all. ‘Perfect anonymity, perfect secrecy, and perfect security,’ he wrote, ‘... combined with the ease and security with which these contributions could be collected, would make being an abusive government employee an extremely risky proposition. Chances are good that nobody above the level of county commissioner would even risk staying in office.’ In 1995, when Bell wrote ‘Assassination Politics,’ this was all hypothetical. Although Bell believed his market would ultimately lead to the collapse of every government in the world, reality hadn’t caught up with his imagination. Nearly two decades later, with the creation of digital currencies like Bitcoin, anonymous browsers like Tor and trustworthy encryption systems, it had, and Bell’s vision was realized.”

Bartlett, Jamie (2015): *The dark net. Inside the digital underworld*, Melville House, Brooklyn & London.

171. Cybersecurity

“At present, more than half the world’s population is connected in some way to cyberspace. Those who are not presently connected are expected to come online in the years to come. At the close of 2017, by some estimates, more than 250,000 new pieces of malicious software (malware) were being released daily. The growth and diversity of malware spreading within cyberspace are having a substantial impact on nation states, businesses and individuals. Global anti-virus firm Symantec estimated that 978 million people in 20 countries were affected by cybercrime, equating to a total of approximately \$172 billion or \$142 per person in 2017. Other malicious activities in cyberspace – such as espionage, Distributed Denial of Service (DDoS) attacks, social engineering, information operations and a host of other activities – are challenging modern societies in new ways.”

“The authoritarian nature of the Chinese regime shapes its conception of cybersecurity and use of cyber power. At the domestic level, China has sought to control the flow of external information into the national sphere, to exert sovereignty over its society. For the Chinese government, Internet threats are not only technical but also informational. While various democratic nations, such as the United States and Sweden, monitor Internet traffic in and out of their country, China filters out unwanted content. To control information Chinese authorities have developed a ‘golden shield,’ colloquially known as the Great Firewall of China (...) This effort to censor the Internet aims to limit the influence of Western media and other news sources, which are seen as subversive tools that threaten the stability of the regime. Chinese ‘netizens’ do not have access to a number of foreign websites and applications, such as Facebook and Google Maps (...) China has focused its efforts on cyber espionage and the theft of intellectual property in order to develop an informational advantage across the fields of economics, military affairs, politics and technology, and to weaken the operational efficiency of its adversaries.”

“Russia maintains a holistic approach to cybersecurity that considers strategic interactions across all the elements of power. This approach is well suited to the all-encompassing nature of computer networks in modern societies. At the domestic level, Russian authorities have sought to control the flow of information and data in cyberspace to maintain national sovereignty (...) Russia has not built a Great Firewall, but the government supervises the media to make sure they promote patriotic values and traditions (...) To limit Western influence and maintain its sovereignty, Russia has expressed a desire to develop an independent Internet and create its own domain name system that would limit external influences.”

“At the international level, Russia leverages cyberspace as an asymmetric means to engage with an adversary (the West) that is stronger in other elements (economy, military). Here, Russian use of cyber operations to project power and sow chaos contrasts with the more defensive outlook of Chinese cyber strategy. In Russia, cyber operations are construed as a form of information warfare that seeks to disrupt enemy civil–military facilities and systems, leadership, troops and populations. Russian doctrine attributes great importance to the role of public perception and seeks to exploit psychological and cognitive factors as a part of a broader informational struggle (...) Experts expect Russia to continue its propaganda and disinformation campaign to further exacerbate social and political fissures in the United States, and beyond.”

“The United States is one of the most connected nations in the world – its economy, civilian infrastructure and government services are all highly dependent on cyberspace. Unlike China and Russia, the United States actively defends and promotes freedoms – specifically, freedom of speech – in cyberspace. The technological dependency and openness of the United States have created significant vulnerabilities that its adversaries have sought to exploit (...) The US government has embraced cyberspace as an instrument of soft and hard power (...) Critics note that the division of labor that characterizes American society limits the US ability to anticipate and respond to problems in a timely and coherent way.”

Van Puyvelde, Damien; Aaron Franklin Brantly (2019): *Cybersecurity. Politics, governance and conflict in cyberspace*, Polity Press, Cambridge, UK and Medford, MA.

172. Three categories of AI

“*Artificial narrow intelligence* (ANI) is machine expertise at a specific task. Many diverse examples of ANI exist today (...) such as the visual recognition of objects, real-time machine translation between natural languages, automated financial-trading systems, AlphaZero, and self-driving cars.”

“*Artificial general intelligence* (AGI) would involve a single algorithm that could perform well at all of the tasks described in the preceding paragraph: It would be able to recognize your face, translate this book into another language, optimize your investment portfolio, beat you at Go, and drive you safely to your holiday destination. Indeed, such an algorithm would be approximately indistinguishable from the intellectual capabilities of an individual human (...) In a study conducted by the philosopher Vincent Müller and the influential futurist Nick Bostrom, the median estimate across hundreds of professional AI researchers is that AGI will be attained in the year 2040.”

[Müller, V., and Bostrom, N. (2014). Future progress in artificial intelligence: A survey of expert opinion. In V. Müller (Ed.), *Fundamental Issues of Artificial Intelligence*. Berlin: Springer.]

“*Artificial super intelligence* (ASI) (...) would be an algorithm that is markedly more advanced than the intellectual capabilities of a human. If AGI is possible, then ASI may be as well (...) Citing the Müller and Bostrom survey again, however, AI experts’ median estimate for the arrival of ASI is 2060.”

Krohn, Jon; with Grant Beyleveld and Aglaé Bassens (2020): *Deep learning illustrated. A visual, interactive guide to Artificial Intelligence*, Addison-Wesley, Boston.

“People are just curious. What follows in the wake of their discoveries is something for the next generation to worry about.” —Werner von Braun